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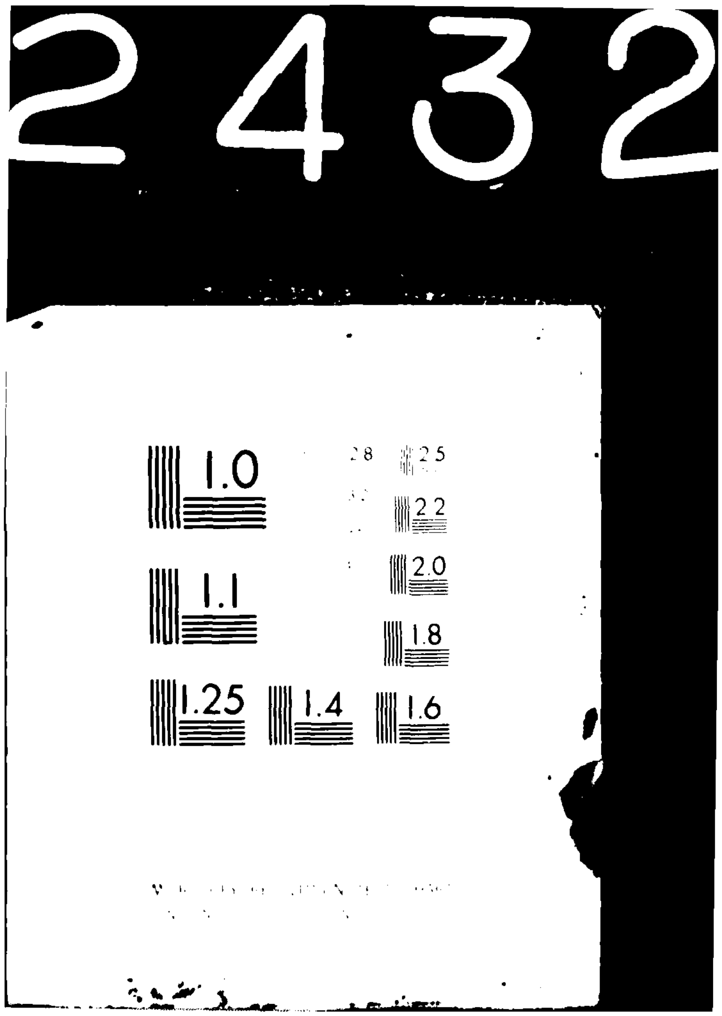
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MUNICIPAL WATER-SUPPLY AND WASTE-WATER TREATMENT FACILITIES IN SELECTED NEVADA AND UTAH COMMUNITIES

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

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This report presents results of municipal water-supply + waste-water treatment systems in ~~U-N MX siting area~~. Utah and Nevada MX [illegible] area.

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FOREWORD

This report presents the results of the municipal water-supply and waste-water treatment systems in the Utah-Nevada MX siting area. It was prepared as part of the MX Water Resources Program for the Ballistic Missile Office (BMO), in compliance with Contract No. F04704-80-C-0006 CDRL Item 004A2. It includes a summary of the reports on the municipal systems in the area and the complete reports of the Desert Research Institutes and the Utah Water Research Laboratory as Appendices A and B. Appendices A and B of this report were originally presented as Appendices L and K, Vol. III, of "MX Siting Investigation Water Resource Program Summary for Draft Environmental Impact Statement" (15 May 1980).

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B	Municipal Water Resources Analysis for Area Potentially Impacted by MX Missile Complex in Utah

1.0 INTRODUCTION

This report presents the results of the studies of municipal water supply and wastewater-treatment systems in the Utah-Nevada MX siting area. The studies were conducted by the Desert Research Institute (DRI) in Nevada and the Utah Water Research Laboratory (UWRL) in Utah. The reports of DRI and UWRL are included as Appendices A and B. The objectives of the studies were to determine the adequacy of the existing systems and their potential to expand to accommodate population growth related to MX construction and operations for the towns within and immediately adjacent to the siting area.

There are 11 water-supply systems and 11 wastewater-treatment systems in the Nevada part of the study area that serve a total population of about 15,000, ranging in size from 400 each in Eureka, Goldfield, and Austin (Lander County Sewer and Water District No. 2), to 6000 in Ely. Water sources for the water-supply systems are wells and springs with one stream, Duck Creek, which is used by McGill. There are five water-supply systems and five wastewater systems in the Utah study area that serve a total of about 18,000 people and range in size from 60 people in Garrison to 13,000 in Cedar City. The water sources in the Utah water-supply systems are wells and springs.

2.0 SUMMARY OF CONCLUSIONS

The general conclusions of the DRI and UWRL studies in Nevada and Utah, respectively, are that significant capital expenditures will have to be made to accommodate water-supply and wastewater-treatment requirements of MX-related population growth. Many of the wastewater-treatment systems do not now meet state legal requirements for effluent quality and operational procedures. The wastewater systems can be improved and expanded if funding can be obtained. The water-supply systems are also expandable given proper funding, but in Milford, Utah water rights are not available by appropriation and will have to be purchased from existing water users.

The results of the studies are summarized in Tables 1, 2, 3, and 4.

LOCATION	POPULATION ESTIMATE SERVED	QUALITY	SOURCE	ADEQUACY	MAXIMUM POPULATION*	IMPROVEMENTS REQUIRED TO
EUREKA COUNTY						
Eureka Water Assn. Eureka	400	Meets Public Health Standards - color, taste, turbidity problems	3 wells several springs	System inadequate to meet current level of demand due to inadequate storage	800	The system production capability at 200 storage would need to be significantly distribution system are required.
ESMERALDA COUNTY						
Goldfield Town Supply	400	Meets Public Health Standards	1 well 1 spring	Inadequate to meet current level of demand. System upgrade active	1500	The maximum population the Goldfield su ing a reliable capacity of 400 gpm (25 bution system.
LANDER COUNTY						
Lander County Sewer & Water Dist. No. 2	400	Meets Public Health Standards	3 wells 2 springs	Inadequate to meet current demands during drought periods	600	Under normal hydrologic conditions the additional people. The supply would not expansion would require sources from the up to Austin.
LINCOLN COUNTY						
Alamo Farmstead Assn.	900	Meets Public Health Standards	4 wells	Inadequate to reliably meet present demands. System upgrade active. Distribution system deteriorated.	2400	The existing system is inadequate to me is based on the current population, but meet this expanded demand with expanded present the 600 gpm (38 l/s) is only we
Caliente Public Utilities Caliente	1000	Meets Public Health Standards - hard, high F	3 wells	The existing system uses only one of the three wells. It is adequate to supply current demands, but backup capacity is inadequate	7500	To serve additional population the Cali reliable capacity near that of the pri but quality and sustained production m service area and storage increases woul
Panaca Farmstead Assn. Panaca	725	Meets Public Health Standard	2 wells	System inadequate during high demand summer months due to inadequate storage	1800	The existing water rights and wells are existing population. Expansion to thi and increases in distribution main si
Pioche Public Utilities Pioche	640	Meets Public Health Standards - supply very hard	3 wells 1 spring	Supply adequate for existing demand level. Distribution system needs replacement	650	The existing and proposed upgraded Pio increase in demand. If the system were together with additional storage.
NYE COUNTY						
Tonopah Public Utilities Tonapah	2700	Meets Public Health Standards	6 wells	System adequate to meet current level of demand	5000	The present supply system is believed mately twice the current water. It m at both booster stations on the trans ditional storage. Any demand beyond 5 The actual supply system capacity is
WHITE PINE COUNTY						
Ely Municipal Water	6000	Meets Public Health Standards	2 wells 1 spring	System adequate to meet current level of demand	up to 50,000	The existing Ely supply system has a from springs and wells which can reli In order to meet very large growth up tantial ground-water rights in Steptoe (0.74 m^3/s) for average demand plus 3 is a designated basin these quantitie
Ruth-McGill Water Company McGill	1500	Meets Public Health Standards	1 well 1 surface source (Duck Creek)	System adequate for current level of demand. Supply is excess from Kennecott Copper Corporation. Distribution system in poor condition	1500	The system is limited to current popu "surplus" water from Kennecott Copper growth were to occur groundwater from could be acquired from present rights
Ruth-McGill Water Company Ruth	600	Meets Public Health Standards	2 springs	System inadequate for current level of demand during dry years. Distribution system needs replacement. Supply is surplus purchased from Kennecott Copper Corp.	600	The Ruth water supply is presently in is supplied to Ruth as "surplus" by amount of "surplus" will increase. identified in the Ruth area.

*Maximum population was estimated using 350 gpcd for unmetered supply systems and th in the discussion.

IMUM LATION*	IMPROVEMENTS REQUIRED TO SERVE MAXIMUM POPULATION ESTIMATES
800	The system production capability at 200 gpm (12.6 l/s) could serve 800 persons. The system storage would need to be significantly increased and the replacement and expansion of the distribution system are required.
1500	The maximum population the Goldfield supply could support is based on the new well having a reliable capacity of 400 gpm (25 l/s) and expansion and replacement of the distribution system.
600	Under normal hydrologic conditions the town supply system could serve approximately 200 additional people. The supply would not be adequate during dry years. Any further expansion would require sources from the Reese River Valley to be developed and pumped up to Austin.
2400	The existing system is inadequate to meet present levels of demand. The system upgrade is based on the current population, but the potential new supply at 600 gpm (38 l/s) could meet this expanded demand with expanded storage and distribution and additional backup. At present the 600 gpm (38 l/s) is only well design criteria.
7500	To serve additional population the Caliente supply would require several new wells with reliable capacity near that of the primary well used today. Water quantity is adequate but quality and sustained production may be problems. Expansion of the distribution service area and storage increases would also be required.
1800	The existing water rights and wells are capable of serving a population over double the existing population. Expansion to this level requires substantial addition of storage and increases in distribution main sizes as well as upgrading the pumping facilities.
650	The existing and proposed upgraded Pioche water supply system does not allow for any increase in demand. If the system were to be expanded new supply sources will be required together with additional storage.
5000	The present supply system is believed to be capable of producing and distributing approximately twice the current water. It may be necessary to upgrade the pumping facilities at both booster stations on the transmission system. New growth will also require additional storage. Any demand beyond 5000 level may require sources of potable water. The actual supply system capacity is unknown.
to ,000	The existing Ely supply system has a capability of furnishing approximately 4000 gpm (252 l/s) from springs and wells which can reliably supply 8000 persons considering a 100% backup. In order to meet very large growth up to maximum the city would have to acquire substantial ground-water rights in Steptoe Valley. This has been estimated at 26 cfs (0.74 m^3/s) for average demand plus 36 cfs (1 m^3/s) for peak demand. Since Steptoe Valley is a designated basin these quantities may not be available for domestic purposes.
2500	The system is limited to current population level since the primary source of supply is "surplus" water from Kennecott Copper Corporation's Duck Creek supply. If additional growth were to occur groundwater from Steptoe Valley might be a source of supply if it could be acquired from present rights holders.
600	The Ruth water supply is presently inadequate for current levels of demand. The water is supplied to Ruth as "surplus" by Kennecott Corporation and it does not appear that the amount of "surplus" will increase. There have been no other reliable potable supplies identified in the Ruth area.

350 gpcd for unmetered supply systems and the system reliable production unless otherwise noted

MUNICIPAL WATER SUPPLY SYSTEMS, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 1

FUGRO NATIONAL, INC.

LOCATION	POPULATION ESTIMATE SERVED	QUALITY	SOURCE	ADEQUACY	MAXIMUM POPULATION*	IMPROVEMENTS REQUIREI
Milford	1,500	Reversal of vertical gradient is causing salinity increase in lower aquifers.	5 wells, water rights for 1978 gpm (125 l/s).	The system is adequate for the present population with a 30 percent excess capacity. There is not enough capacity for a major (5 hour) fire.	1,950 (based on estimate of 30 percent over capacity)	System should be metered. Pres Mains are in poor repair. Reme appropriated, so any increase i
Delta City	2,100	Good (TDS is 250 to 500 mg/l).	3 wells, water rights for 1910 gpm (121 l/s).	Wells and pumps are adquate for twice the present peak flow (1895 gpm with 90 percent use rate) storage for fire flow adequate.	5,000 (based on 1895 gpm and peak use of 546 gpd per capita)	Mains and wells are adequate. (2,271,000 l) to 1,800,000 gall To accomodate MX related growth sent holders. No additional ap
Cedar City	13,000	Has low TDS (less than 400 mg/l) but long term deterioration is expected due to the basin being closed.	6 wells and 14 springs.	System is adequate on peak day of year with a 14 percent excess capacity.	14,900 (1987 population based on current trends (no MX)	Except for a few peak days per growth through 1987. In 1987, average days, but for peak days
Hinckley, Deseret, and Oasis	900	Aresenic exceeds allowable limits.	Hinckley has municipal system. The other communities have private wells. Rights total about 2100 gpm (132 l/s).	System adequate for present population, but increasing arsenic levels will necessitate a new well north of the towns.	900	Sixty thousand gallons (227,10 the population for fire require per connection is recommended f
Garrison	60	Good.	Private wells.	There is currently no municipal system.	—	Adequate ground water is avail thousands. All development wo is no municipal institution re

IMPROVEMENTS REQUIRED TO SERVE MAXIMUM POPULATION ESTIMATES

System should be metered. Present flat rate produces no incentive to conserve. Mains are in poor repair. Reservoirs have some leakage. The area is presently over appropriated, so any increase in water rights would have to be purchased.

5
Mains and wells are adequate. Storage needs to be increased from 600,000 gallons (2,271,000 l) to 1,800,000 gallons (6,813,000 l) to meet fire flow requirements. To accomodate MX related growth, water rights would have to be purchased from present holders. No additional appropriations are being allowed.

Except for a few peak days per year, the system is adquate for non-MX normal growth through 1987. In 1987, with MX growth, the system will be adequate for average days, but for peak days it will be 32 percent short.

Sixty thousand gallons (227,100 l) of storage capacity needs to be added to serve the population for fire requirements. Additional storage at 400 gallons (1516 l) per connection is recommended for new growth.

Adequate ground water is available in this area to accommodate a population of many thousands. All development would have to be done by the MX project, since there is no municipal institution responsible for water in Garrison.

MUNICIPAL WATER SUPPLY SYSTEMS, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 2

FUGRO NATIONAL, INC.

LOCATION	POPULATION ESTIMATES SERVED	TREATMENT SYSTEM	ADEQUACY	MAXIMUM POPULATION* PROJECTION	IMPROVEMENTS RE
EUREKA COUNTY					
Eureka Water Assn. Eureka	400	Gravity sewer, two raw sewage oxidation ponds, active discharge to dry wash.	The existing treatment for Eureka wastewater does not meet standards. Collection system in need of replacement.	600	The community of Eureka The new system, oxidati facilities could easily upgrade also includes re
ESMERALDA COUNTY					
Goldfield Town Supply	400	Gravity sewer. Three raw sewage oxidation, evaporation percolation ponds. No discharge.	The existing Goldfield wastewater treatment facilities are more than adequate to meet current levels of demand. There is no active discharge from the pond system. Collection system is in good condition.	1000	The existing Goldfield 1000 persons. The coll the 1000 population wil collection facilities.
LANDER COUNTY					
Lander Co. Sewer & Water Dist. No. 2 Austin	400	Gravity sewer. Two 1/2 acre (0.2 hectares) oxidation ponds. Active discharge to dry wash.	The Austin wastewater treatment system does not meet state standards. The collection system is in good condition.	600	The community of Austin system could be upgraded ing active discharge. least 600 people. Furt system.
LINCOLN COUNTY					
Alamo Farmstead Assn. Alamo	900	Three oxidation, evaporation percolation ponds--effluent pumped to ponds. No discharge.	The existing Alamo system is adequate for over twice the current population. The lift station is at capacity. The collection system is in good condition.	2500	The Alamo waste treatm persons. To meet this expanded and the lift since they are at capac
Caliente Public Utilities Caliente	1000	Gravity sewer, extended aeration, activated sludge plant. Discharge to Meadow Valley Wash. Has site discharge permit.	The treatment plant does not meet the discharge permit requirements. Hydraulic capacity more than adequate but high infiltration of fresh water into collection system decreases plant efficiency.	3200	The Caliente waste trea sons at 125 gpcd. The operates below design e will have to eliminate In order to meet their operator to keep the pl procedures may have to
Panaca Farmstead Assn. Panaca	725	Three raw sewage oxidation, evaporation, percolation ponds. No discharge.	The existing wastewater treatment collection and treatment facilities are adequate. There are some odor problems associated with the pond system.	700	The Panaca wastewater t isting flows. Any expa ment train, expanding t system service area will
Pioche Public Utilities Pioche	640	Gravity sewer, mechanical aeration, evaporation percolation. No discharge.	The Pioche wastewater treatment collection systems are more than adequate to meet current demands. Mechanical aerators are turned off during winter due to ice.	1500	The Pioche aerated lag tem could handle expans Land is available to ac adequate hydraulic capa
Tonopah Public Utilities Tonopah	2700	Two unsealed raw sewage oxidation, evaporation ponds. Some mechanical aeration.	The present pond system does not provide adequate waste treatment for Tonopah. The town is replacing the existing facility.	5000	The new treatment facil an increase of approxim only to handle the expe plant will be at capcity not connect to the Tono new treatment facility ties are located in Esme posal options.
WHITE PINE COUNTY					
Ely Municipal Water Ely	6000	Extended aeration and oxidation ponds. Possible discharge to Murry Creek.	The existing Ely wastewater treatment and collection systems are more than adequate for the present population. Influent is weak due to collection system infiltration. No active discharge at current levels of use.	18,000	The existing extended a to provide waste treatm planning to eliminate f collection system in or population. Expansion sidered by the city but facilities and include
Ruth-McGill Water Company McGill	1500	Gravity sewer, two oxidation, evaporation, percolation ponds. No active discharge.	The existing pond system is adequate for the current McGill demand. The collection system needs replacement.	1500	The McGill wastewater sy sion capability. Any im Cost estimates just to
Ruth-McGill Water Company Ruth	600	Gravity sewer, four oxidation, evaporation, percolation ponds. No active discharge.	The existing pond system has proved adequate. The upper two ponds are filling with sludge and the lower ponds need to be fenced. The collection system is adequate.	600	The Ruth wastewater syst existing population. Th ing the hydraulic capaci pond system is possible, expand.

	MAXIMUM POPULATION* PROJECTION	IMPROVEMENTS REQUIRED TO SERVE MAXIMUM POPULATION ESTIMATES
f Eureka waste- ards. Collect- lacement.	600	The community of Eureka is presently upgrading its wastewater facilities. The new system, oxidation ponds, has a design population of 600. The new facilities could easily be expanded to accommodate a larger population. The upgrade also includes replacement of 70% of the existing collection system.
stewater treat- than adequate to mand. There is the pond system. ood condition.	1000	The existing Goldfield treatment ponds have a capacity for approximately 1000 persons. The collection system is in good condition. Expansion beyond the 1000 population will require an expansion of the ponds and increased collection facilities.
atment system does The collection m.	600	The community of Austin does not now meet state standards. Its treatment system could be upgraded by expanding the oxidation pond system and eliminating active discharge. The collection system is adequately sized to serve at least 600 people. Further expansion would require expansion of the collection system.
is adequate for ulation. The y. The collec- ition.	2500	The Alamo waste treatment facilities have a design capacity to serve 2500 persons. To meet this demand the collection system would have to be greatly expanded and the lift station to the treatment ponds would require new pumps since they are at capacity with the existing flows.
ot meet the ts. Hydraulic e but high r into col- lant effi-	3200	The Caliente waste treatment facilities have a design population of 3200 persons at 125 gpcd. The existing plant influent is quite dilute. The plant operates below design efficiency. To meet the design population the city will have to eliminate the large quantities of fresh water in the influent. In order to meet their NPDES criteria the facility also requires a full time operator to keep the plant operating at design efficiency. Sludge handling procedures may have to be revised also.
atment col- ities are dor prob- nd system.	700	The Panaca wastewater treatment pond system is designed to meet only the existing flows. Any expansion of service would require a revision of the treatment train, expanding the pond system and providing aeration. The collection system service area will require expansion to meet increased population demands.
ment collection ate to meet cur- erators are e to ice.	1500	The Pioche aerated lagoon system design population is 1500. The existing system could handle expansion beyond this population by increasing the ponds. Land is available to accommodate expansion. The collector system has more than adequate hydraulic capacity.
s not provide ade- onopah. The town acility.	5000	The new treatment facility for Tonopah has a design population of 5000, an increase of approximately 2200 persons. This capacity will be adequate only to handle the expected increase due to increased mining activity and the plant will be at capcity within two years. If the major new development does not connect to the Tonopah system, there will be excess capacity. Beyond the new treatment facility Tonopah has no expansion plans. The treatment facilities are located in Esmeralda County which somewhat restricts Tonopah's disposal options.
treatment and than adequate Influent is m infiltration. nt levels of use.	18,000	The existing extended aeration and oxidation pond system in Ely should be able to provide waste treatment for triple the existing population. The city is planning to eliminate flush tanks and eliminate the high infiltration in the collection system in order to bring the system capability up to the design population. Expansion beyond the design capacity has not been seriously considered by the city but would most likely require relocation of the treatment facilities and include a reuse of plant effluent.
adequate for The collection	1500	The McGill wastewater system is in need of total replacement and has no expansion capability. Any increase in demand would require a complete new system. Cost estimates just to replace the existing system are in excess of $2,500,000.
proved adequate. ing with sludge be fenced. The e.	600	The Ruth wastewater system of four oxidation ponds is only adequate for the existing population. The upper ponds are filling with sludge, thereby reducing the hydraulic capacity of the pond system. Some limited expansion of the pond system is possible, but the system owner has no financial capability to expand.

MUNICIPAL WASTEWATER SYSTEMS, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE
3

FUGRO NATIONAL, INC.

LOCATION	POPULATION ESTIMATE SERVED	TREATMENT SYSTEM	ADEQUACY	MAXIMUM POPULATION* PROJECTION	IMPROVEMENT
Milford	1,500	Gravity clay sewer, one lift station, oxidation ponds.	Does not meet state standards. Collection system has inadequate grades, material break-down and cracking, and under sized lines. No discharge.	14,500	A completely new existing system oxidation ponds
Delta City	2,100	Gravity clay sewer, three lift stations, one 6-cell oxidation pond. No discharge.	The system meets requirements for the present population.	15,000	Completely new c containment lag
Cedar City	13,000	Gravity sewer, filtration, digesters, clarifiers.	The plant effluent currently exceeds state limits but is not operating at design criteria. It is designed for a population of 19,000.	19,000	The current syst overload. New o
Hinckley Deseret Oasis	900	Individual septic tank - drainfield systems.	Low percolation rates render drainfields ineffective. There are present health hazards due to surface discharge of sewage.	?	An entire system
Garrison	60	Individual septic tank - drainfield systems.	Systems are adequate for present population.	?	An entire system

* Maximum population is based on 1987 peak contruction period population projecti

	MAXIMUM POPULATION* PROJECTION	IMPROVEMENTS REQUIRED TO SERVE MAXIMUM POPULATION ESTIMATES
...ah- ...No	14,500	A completely new collector system and replacement of major portions of the existing system will be required. Two hundred twenty-two acres (90 hectares) of oxidation ponds will be required.
	15,000	Completely new collection system with lift stations will be required. A new containment lagoon of 187 acres (76 hectares) will be required.
	19,000	The current system, operating at design criteria, would have a five percent overload. New oxidation ponds and sand filters would be required.
...ef- ...due	?	An entire system would have to be built to accommodate major growth.
...	?	An entire system would have to be built to accomodate major growth.

...contruction period population projection.

MUNICIPAL WASTEWATER SYSTEMS, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE
4

FUGRO NATIONAL, INC.

APPENDIX A

Review and Evaluation of Water Supply and Wastewater Facilities for Selected Rural Nevada Communities

REVIEW AND EVALUATION OF WATER SUPPLY AND WASTEWATER FACILITIES FOR SELECTED RURAL NEVADA COMMUNITIES

by

J.W. Fordham

G.F. Cochran

Water Resources Center
Desert Research Institute

submitted to

FUGRO NATIONAL, INC.
Long Beach, California

Contract Number 79-290-42

ACKNOWLEDGMENTS

During the course of this study we received full cooperation from all those contacted. We would like to express thanks to the state and county agencies, the community and civic leaders, private consultants, and residents of the communities for their cooperation.

Summary

The following tables provide a summary by community of the 1) existing water supply system, 2) water supply system capacity, 3) existing wastewater system and 4) wastewater system expansion capabilities for the twelve rural Nevada communities most likely to be impacted by the proposed MX project. These summaries should be evaluated in light of the following discussion.

In general, the water supply and wastewater treatment systems for the rural communities considered are only sufficient to provide for the existing population. Any upgrades, whether in recent past or planned for the near future, have been or are predicated on providing a reliable service for the existing community with little expansion considered. The populations have been relatively stable and financial abilities are severely limited. Ely is an exception, being the largest of the communities and self-governing.

The most significant problem any of the communities would have in expanding water supply or wastewater facilities relates to financial considerations. The communities, without exception, do not have financial resources to readily expand their systems. In the past most upgrades and replacement financing has been in the form of outright grants (EPA, HUD, Fm HA, Four Corners Regional Commission) and low interest loans from Farmers Home Administration. System generated revenues are for the most part set to provide for operation, maintenance, and debt service without building a capital reserve. Some systems require funds from the county to supplement revenue. Without considerable financial assistance the impact of a large population influx on any of these communities will be severe.

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  - Austin
- Lincoln County
  - Alamo
  - Caliente
  - Panaca
  - Pioche
- Nye County
  - Tonopah
- White Pine County
  - Ely
  - McGill
  - Ruth
  - Baker
  - Preston
  - Lund

EXISTING WATER SUPPLY

NAME, LOCATION	POPULATION ESTIMATE SERVED	QUALITY	SOURCE	ADEQUACY
EUREKA COUNTY				
Eureka Water Assn. Eureka	400	Meets Public Health Standards - color, taste, turbidity problems	3 wells several springs	System inadequate to meet current level of demand due to inadequate storage
ESMERALDA COUNTY				
Goldfield Town Supply	400	Meets Public Health Standards	1 well 1 spring	Inadequate to meet current level of demand. System upgrade active
LANDER COUNTY				
Lander Co. Sewer & Water Dist. No. 2 Austin	400	Meets Public Health Standards	3 wells 2 springs	Inadequate to meet current demands during drought periods
LINCOLN COUNTY				
Alamo Farmstead Assn. - Alamo	900	Meets Public Health Standards	4 wells	Inadequate to reliably meet present demands. System upgrade active. Distribution system deteriorated.
Caliente Public Utilities Caliente	1000	Meets Public Health Standards - hard, high F	3 wells	The existing system uses only one of the three wells. It is adequate to supply current demands, but backup capacity is inadequate
Panaca Farmstead Assn. - Panaca	725	Meets Public Health	2 wells	System inadequate during high demand summer months due to inadequate storage
Pioche Public Utilities Pioche	640	Meets Public Health Standards - supply very hard	3 wells 1 spring	Supply adequate for existing demand level. Distribution system needs replacement
NYE COUNTY				
Tonopah Public Utilities Tonopah	2700	Meets Public Health Standards	6 wells	System adequate to meet current level of demand

Table (contd)

NAME, LOCATION	POPULATION ESTIMATE SERVED	QUALITY	SOURCE	ADEQUACY
WHITE PINE COUNTY				
Ely Municipal Water - Ely	6000	Meets Public Health Standards	2 wells 1 spring	System adequate to meet current level of demand
Ruth-McGill Water Company McGill	1500	Meets Public Health Standards	1 well 1 surface source (Duck Creek)	System adequate for current level of demand. Supply is excess from Kennecott Copper Corporation. Distribution system in poor condition
Ruth-McGill Water Company Ruth	600	Meets Public Health Standards	2 springs	System inadequate for current level of demand during dry years. Distribution system needs replacement. Supply is surplus purchased from Kennecott Copper Corp.

WATER SUPPLY SYSTEM CAPACITY

NAME, LOCATION	MAXIMUM POPULATION*	IMPROVEMENTS REQUIRED TO SERVE POPULATION ESTIMATES
EUREKA COUNTY		
Eureka Water Assn. - Eureka	800	The system production capability at 200 gpm could serve 800 persons. The system storage would need to be significantly increased and the replacement and expansion of the distribution system are required.
ESMERALDA COUNTY		
Goldfield Town Supply	1500	The maximum population the Goldfield supply could support is based on the new well having a reliable capacity of 400 gpm and expansion and replacement of the distribution system.
LANDER COUNTY		
Lander County Sewer and Water District No. 2 - Austin	600	Under normal hydrologic conditions the town supply system could serve approximately 200 additional people. The supply would not be adequate during dry years. Any further expansion would require sources from Reese River Valley to be developed and pumped up to Austin.
LINCOLN COUNTY		
Alamo Farmstead Association	2400	The existing system is inadequate to meet present levels of demand. The system upgrade is based on the current population, but the potential new supply at 600 gpm could meet this expanded demand with expanded storage and distribution and additional backup. At present the 600 gpm is only well design criteria.
Caliente Public Utilities - Caliente	7500	To serve additional population the Caliente supply would require several new wells with reliable capacity near that of the primary well used today. Water quantity is adequate but quality and sustained production may be problems. Expansion of the distribution service area and storage increases would also be required.
Panaca Farmstead Assoc. - Panaca	1800	The existing water rights and wells are capable of serving a population over double the existing population. Expansion to this level requires substantial addition of storage and increases in distribution main sizes as well as upgrading the pumping facilities.
Pioche Public Utilities - Pioche	650	The existing and proposed upgraded Pioche water supply system does not allow for any increase in demand. If the system were to be expanded new supply sources will be required together with additional storage.

Water Supply System Capacity (cont.)

NAME, LOCATION	MAXIMUM POPULATION*	IMPROVEMENTS REQUIRED TO SERVE POPULATION ESTIMATES
NYE COUNTY		
Tonopah Public Utilities - Tonopah	5000	The present supply system is believed to be capable of producing and distributing approximately twice the current water. It may be necessary to upgrade the pumping facilities at both booster stations on the transmission system. New growth will also require additional storage. Any demand beyond 5000 level may require additional sources of potable water. The actual supply system capacity is unknown.
WHITE PINE COUNTY		
Ely Municipal Water - Ely	up to 50,000	The existing Ely supply system has a capability of furnishing approximately 4000 gpm from springs and wells which can reliably supply 8000 persons considering a 100% backup. In order to meet very large growth up to the maximum the city would have to acquire substantial groundwater rights in Steptoe Valley. This has been estimated at 26 cfs for average demand plus 36 cfs for peak demand. Since Steptoe Valley is a designated basin these quantities may not be available for domestic purposes.
Ruth-McGill Water Company - McGill	1500	The system is limited to current population level since the primary source of supply is "surplus" water from Kennecott Copper Corporation's Duck Creek supply. If additional growth were to occur groundwater from Steptoe Valley might be a source of supply.
Ruth-McGill Water Company - Ruth	600	The Ruth water supply is presently inadequate for current levels of demand. The water is supplied to Ruth as "surplus" by Kennecott Corporation and it does not appear that the amount of "surplus" will increase. There have been no other reliable potable supplies identified in the Ruth area.

*Maximum population was estimated using 350 gpcd for unmetered supply systems and the system reliable production unless otherwise noted in the discussion.

EXISTING WASTEWATER SYSTEM

NAME, LOCATION	POPULATION ESTIMATE SERVED	TREATMENT SYSTEM	ADEQUACY
EUREKA COUNTY			
Eureka Water Assn. Eureka	400	Two raw sewage oxidation ponds, active discharge dry wash, gravity sewer	The existing treatment for Eureka wastewater does not meet standards. Collection system in need of replacement.
ESMERALDA COUNTY			
Goldfield Town Supply	400	Gravity sewer. Three raw sewage oxidation, evaporation percolation ponds. No discharge.	The existing Goldfield wastewater treatment facilities are more than adequate to meet current levels of demand. There is no active discharge from the pond system. Collection system in good condition
LANDER COUNTY			
Lander Co. Sewer & Water Dist. No. 2 Austin	400	Gravity sewer. Two 1/2 acre oxidation ponds. Active discharge to dry wash.	The Austin wastewater treatment does not meet state standards. The collection system is in good condition.
LINCOLN COUNTY			
Alamo Farmstead Assn. - Alamo	900	Three oxidation, evaporation percolation ponds--effluent pumped to ponds. No discharge.	The existing Alamo system is adequate for over twice the current population. The lift station is at capacity. Collection system is in good condition.
Caliente Public Utilities Caliente	1000	Extended aeration, activated sludge plant. Discharge to Meadow Valley Wash. Gravity sewer. NPDES permit.	Treatment plant does not meet the NPDES permit requirements. Hydraulic capacity more than adequate but high infiltration of fresh water into collection system decreases plant efficiency.
Panaca Farmstead Assn. - Panaca	725	Three raw sewage oxidation, evaporation percolation. No discharge.	The existing wastewater treatment collection and treatment facilities are adequate. There are some odor problems associated with the pond system.
Pioche Public Utilities Pioche	640	Mechanical aeration, evaporation percolation gravity sewer. No discharge.	The Pioche wastewater treatment and collection systems are more than adequate to meet current demands. Mechanical aerators turned off during winter due to ice.

Table (contd)

NAME, LOCATION	POPULATION ESTIMATE SERVED	TREATMENT SYSTEM	ADEQUACY
NYE COUNTY			
Tonopah Public Utilities Tonopah	2700	Two unsealed raw sewage oxidation, evaporation, ponds. Some mechanical aeration.	The present pond system does not provide adequate waste treatment for Tonopah. The town is replacing the existing facility.
WHITE PINE COUNTY			
Ely Municipal Water - Ely	6000	Extended aeration and oxidation ponds. Possible discharge to Murry Creek.	The existing Ely wastewater treatment and collection systems are more than adequate for the present population. Influent is weak due to collection system infiltration. No active discharge at current levels of use.
Ruth-McGill Water Company McGill	1500	Two oxidation, evaporation, percolation ponds. No active discharge. Gravity sewer	The existing pond system is adequate for the current McGill demand. The collection system needs replacement.
Ruth-McGill Water Company Ruth	600	Four oxidation, evaporation, percolation ponds. No active discharge. Gravity sewer.	The existing pond system has proved adquate. The upper two ponds are filling with sludge and the lower ponds need to be fenced. The collection system is adequate.

WASTEWATER TREATMENT EXPANSION CAPABILITY

NAME, LOCATION	MAXIMUM POPULATION*	IMPROVEMENTS REQUIRED TO SERVE POPULATION ESTIMATES
EUREKA COUNTY		
Eureka Water Assn. - Eureka	600	The community of Eureka is presently upgrading their wastewater facilities. The new system, oxidation ponds, has a design population of 600. The new facilities could easily be expanded to accommodate a larger population. The upgrade also includes replacement of 70% of the existing collection system.
ESMERALDA COUNTY		
Goldfield Town Supply	1000	The existing Goldfield treatment ponds have a capacity for approximately 1000 persons. The collection system is in good condition. Expansion beyond the 1000 population will require an expansion of the ponds and increased collection facilities.
LANDER COUNTY		
Lander Co. Sewer & Water Dist. No. 2 Austin	600	The community of Austin does not now meet state standards. Its treatment system could be upgraded by expanding the oxidation pond system eliminating active discharge. The collection system is adequately sized to serve at least 600 people. Further expansion would require expansion of the collection system.
LINCOLN COUNTY		
Alams Farmstead Assn. - Alamo	2500	The Alamo waste treatment facilities have a design capacity to serve 2500 persons. To meet this demand the collection system would have to be greatly expanded and the lift station to the treatment ponds would require new pumps since they are at capacity with the existing flows.
Caliente Public Utilities Caliente	3200	The Caliente waste treatment facilities have a design population of 3200 persons at 125 gpcd. The existing plant influent is quite dilute and the plant operates below design efficiency. To meet the design population the city will have to eliminate the large quantities of fresh water in the influent. In order to meet their NPDES the facility also requires a full time operator to keep the plant operating at design efficiency. Sludge handling procedures may have to be revised also.
Panaca Farmstead Assn. - Panaca	700	The Panaca wastewater treatment pond system is designed to meet only the existing flows. Any expansion of service would require a revision of the treatment train, expanding the pond system and providing aeration. The collection system service area will require expansion to meet increased population demands.
Pioche Public Utilities Pioche	1500	The Pioche aerated lagood system design population is 1500. The existing system could handle expansion beyond this population by increasing the ponds. Land is available to accommodate expansion. The collector system has more than adequate hydraulic capacity.

Table (contd)

NAME, LOCATION	MAXIMUM POPULATION*	IMPROVEMENTS REQUIRED TO SERVE POPULATION ESTIMATES
NYE COUNTY		
Tonopah Public Utilities Tonopah	5000	The new treatment facility for Tonopah has a design population of 5000, an increase of approximately 2200 persons. This capacity will be adequate only to handle the expected increase due to increased mining activity and the plant will be at capacity within two years. If the major new development does not connect to the Tonopah system, there will be excess capacity. Beyond the new treatment facility Tonopah has no expansion plans. The treatment facilities are located in Esmeralda County which somewhat restricts Tonopah's disposal options.
WHITE PINE COUNTY		
Ely Municipal Water - Ely	18,000	The existing extended aeration and oxidation pond system in Ely should be able to provide waste treatment for triple the existing population. The city is planning to eliminate flush tanks and eliminate the high infiltration in the collection system in order to bring the system capability up to the design population. Expansion beyond the design capacity has not been seriously considered by the city but would most likely require relocation of the treatment facilities and include a reuse of plant effluent.
Ruth-McGill Water Company - McGill	1500	The McGill wastewater system is in need of total replacement and has no expansion capability. Any increase in demand would require a complete new system. Cost estimates just to replace the existing system are in excess of $2,500,000.
Ruth-McGill Water	600	The Ruth wastewater treatment system of four oxidation ponds is only adequate for the existing population. The upper ponds are filling with sludge, thereby reducing the hydraulic capacity of the pond system. Some limited expansion of the pond system is possible, but the system owner has no financial capability to expand.

Introduction and Scope

The purpose of this study has been to evaluate the current status and expansion capabilities of water supply and wastewater facilities of communities in Nevada which may be most directly affected by the MX project.

The focus of this study effort is those communities both within the MX candidate site boundaries and surrounding areas that might be impacted through influx of population working on, or in support of, the MX project. Concern for these water supply and wastewater treatment systems lies in the physical resources and in the institutional and financial framework.

There are well in excess of 100 rural Nevada communities that could conceivably be impacted by the MX project population influx. These communities represent a wide spectrum of institutional forms that have been adopted to handle water supply and wastewater treatment needs. The institutional form seriously affects the efficiency and quickness with which a community can respond to new demands and subsequently operate larger and possibly more complex systems. Illustrative of the existing organizational forms are the following:

	Water Supply	Waste Treatment
1.	private wells	septic tanks
2.	water district	sanitation district
3.	municipal	municipal
4.	private company (regulated)	private company
5.	unincorproated association	unincorporated association
6.	non-profit corporation	public utility district
7.	cooperative	
8.	public utility district	

Prior Work

In 1969 the Nevada State Planning Board contracted with the joint venture of Walters Engineering-Chilton Engineering to develop a "Nevada Rural Communities Water and Waste Water Plan." This contract resulted in a six volume plan, published in 1972, that inventoried all rural Nevada communities. For each of these communities information was compiled for the existing water system and wastewater facility and recommendations were made for improvements. Both the existing systems and recommended improvements were displayed on air photo maps. These six volumes covered the following counties: Vol I - Carson City, Douglas, Storey; Vol II - Churchill, Mineral; Vol III - Lincoln, White Pine; Vol IV - Humboldt, Pershing; Vol V - Eureka, Lander; Vol VI - Esmeralda, Nye. In 1973 Walters Engineering completed a comparable two volume plan for Washoe County under contract with the Washoe County Commissioners.

In 1975 the Water Resources Center of DRI completed an important related study on "Economics and Finance of Nevada Public Water Systems." This study developed data for 71 water systems on: organizational forms; per capita water use; total water use; water rates; financing; and operation and maintenance.

Study Objectives

The basic objective of this study was to develop sound and up-to-date information that can be used as a basis for realistic planning for water and wastewater system expansion to accommodate the MX population influx without undue burden to impacted communities. These data and study conclusions should also permit identification of those communities best capable of handling expansion.

The specific scope of work as defined by the contractor was as follows:

1. An assessment of the existing municipal water resources and the impacts of increased water use on Tonopah, Ely, Caliente and Pioche, Nevada, including the identification of each municipality's source of water, the quantity present, the amount of present usage.

2. Determination of the ability of the water supply and sewage systems to accommodate increased usage, the maximum capacity for increase without modification of the system, and the economics of an increase if modification is required.

3. Evaluation of the water quality limitations of the water supply system.

4. Recommendation of the necessary water supply and wastewater treatment facility improvements required by increased usage.

5. An overview of the effects of increased water usage in small towns such as Baker, Lund, Preston, Alamo, Panaca, and others that lie within or at the margins of the Nevada siting area.

Specifically, the following communities were examined:

Eureka	Tonopah
Goldfield	Ely
Austin	McGill
Alamo	Ruth
Caliente	Baker
Panaca	Preston
Pioche	Lund

Study Methodology

The principal municipalities within and near the boundary of the proposed MX missile siting area are considered in this study. The water use analysis is based upon recent water system planning reports by private consultants, and state and federal agencies, supplemented by communication with community officials, and others. Available information on the design criteria and population projections are utilized in this study.

A listing of information sources for each community considered is included.

The following guide was used in compiling information on each of the communities.

Water Supply and Waste Water Treatment Study

Data Compilation Guideline

I. GENERAL

1. Community Type -- Governing Body

    a. who controls water supply and wastewater?

        1. governmental body

        2. private

    b. who makes the financial decisions?

        1. how funded

        2. other financial resources

    c. how are rates determined?

    d. metered?

2. Does a master plan for water supply and wastewater exist?

    a. original date of plan

    b. level of implementation

    c. update --

        1. existing

        2. planned

3. Current Demand Level

    a. types of demand -- domestic-industrial-fire

    b. adequacy in meeting current levels

4. Future Demand Levels - based on potential future developments

II. WATER SUPPLY

1. Source

    a. physical description

    b. legal (water rights)

2. Physical means of diversion

    a. physical description

    b. condition -- age, capacity, etc...

    c. control of diversion

3. Quality of source
    a. chemical
    b. biological
    c. problems -- historic, current
4. Treatment
    a. type and extent
    b. cost and location
5. Transmission, storage, distribution
    a. physical description
    b. capacity
    c. operational characteristics
    d. condition
    e. losses
    f. fire rating

III. WASTEWATER

1. Collection System
    a. physical description
    b. condition
2. Treatment
    a. type
    b. adequacy
    c. problems
    d. cost
3. Volume and character of influent and effluent
4. Applicable standards and regulations

EUREKA

WATER SUPPLY

1. Existing

The town of Eureka has a current population of approximately 400 people which are served by a combination of wells and springs. The spring sources are approximately five miles south of town in Eureka Canyon. Water is obtained through collectors and moves by gravity to town. In addition the town has three wells with a combined pumping capacity of approximately 375 gpm. The town supply meets State drinking water standards but contains high Se and there are complaints about color, taste and turbidity. The town supply is chlorinated since the spring supply is subject to contamination.

The transmission and distribution system is in varying states of repair. The lines connecting the springs to town are deteriorated and in need of replacement. The distribution system serves only the developed area within its service area. The system is comprised of three pressure zones served by different storage tanks. The system consists of nearly eight miles of pipe ranging up to 6 inch, much of which is in poor condition. The storage facilities are comprised of a 0.3 MG steel tank added in 1968 and a 0.027 small, in ground reservoir providing a total of 0.327 MG storage. This storage volume is barely adequate for the existing community supply and does not provide for adequate fire flows.

2. Future

The existing Eureka water supply is only adequate to meet existing level demand. In order to provide a reliable supply even for existing demands there are several improvements which need to be made. Primarily, the existing distribution system needs replacement with larger lines and storage needs to be increased to approximately twice the current level. Any significant increase in population may stress the supply system beyond any reliable capability. The spring sources are relatively minor, unreliable in dry water years and subject to contamination. The well supply is also only barely adequate with three wells, the best of which produces only 200 gpm. Average daily use is in excess of the "best" well's capability and therefore two or more wells are used. This being the case there is no backup in the existing system and any additional demand would require new sources of water. There have been no recent studies which examined expanding the Eureka town supply.

WASTEWATER

1. Existing

The existing sewer system for the town of Eureka consists of 4 to 8 inch collectors which are in poor condition and in need of replacement. The system has 188 connections serving approximately 400 people. The system discharges to two oxidation ponds in series located northwest of town. Effluent discharges from the second pond to the canyon below. The existing treatment does not meet State standards and work is currently progressing on design of a new system.

2. Future

In the immediate future the town of Eureka will upgrade their wastewater facilities in accordance with a facilities plan prepared in 1976. The new system currently being designed will provide for new collection, treatment and disposal. It is proposed to replace 70% of the existing collection system, mostly with 8 inch lines, and to construct two new 2-1/2 acre oxidation ponds 2 miles north of town. The system is being designed to serve 600 people, an increase of 200 over the current level and to eliminate active discharge thus complying with State requirements. The new wastewater facilities could be expanded rather easily. The new collection system will have hydraulic capacity several times that of the existing system and there is adequate land to increase the oxidation pond size. If demand were to increase above the 600 design population it would probably be necessary to provide aeration to the primary pond.

GOLDFIELD

GENERAL

The community of Goldfield is the county seat of Esmeralda County and has a current population of approximately 400 persons. The community is unincorporated and is governed by the Esmeralda County Commissioners. Both the Goldfield water supply system and wastewater facilities are owned and operated by Esmeralda County. All financial decisions regarding operation, maintenance, expansion or improvement as well as user fees are made by the County.

WATER SUPPLY SYSTEM

1. Existing

The Goldfield water supply system has evolved over the past 80 years changing with the mining activity and population. Goldfield began at the turn of the century when rich ore deposits were discovered. The town was initially supplied by water hauled from surrounding springs. As population and demand grew, a distribution system was constructed and water was supplied from Alkali Spring four miles northwest of Goldfield and by a 30 mile transmission line from Mount Magruder near Lida. As the mining activities and population decreased, the town went back to its original sources, springs and local hand-dug wells. The other supply systems quickly fell into disrepair and deteriorated.

Supply

Goldfield is currently supplied by Rabbit Springs which is a hand-dug well with a production of approximately 55 gpm. In addition, the town has one 8 inch 470 foot deep well capable of producing 100 gpm for domestic purposes. Three other minor sources supply water to the fire tank and are not suitable for domestic purposes. This supply is considered inadequate to meet the demands of current population.

Water Rights

The water rights for the current domestic supply are held by the town of Goldfield. The following is a list of municipal rights held by the town of Goldfield:

Groundwater Certificate No.	Holder	Flow Rate cfs
6199	Town of Goldfield	0.25
6200	Town of Goldfield	0.3
6201	Town of Goldfield	2.0
6216	Town of Goldfield	2.0
6217	Town of Goldfield	4.0
6218	Town of Goldfield	0.25
6219	Town of Goldfield	0.35
6220	Town of Goldfield	0.11
6221	Town of Goldfield	0.30
6222	Town of Goldfield	4.0
7670	Town of Goldfield	0.0225

Groundwater Permit No.	Holder	Flow Rate cfs
27309	Town of Goldfield	0.25

Current Supply Quality and Treatment

The two Goldfield supply sources meet State drinking water standards. The supply is chlorinated.

Transmission and Distribution

The Goldfield distribution system is primarily steel pipe 70 to 80 years old and is deteriorated and in need of replacement. Replacements are made with AC pipe. The system is undersized with 1 to 4 inch mains which do not provide adequate fire flows. The current community fire rating is 9.

Storage on the system is provided by three covered steel tanks located southwest of town. Two tanks comprising 155,000 gallons supply the distribution system. A third tank with a capacity of 85,000 gallons is kept for fire flows and is not used for other purposes. A fourth storage tank further to the south of town with a capacity of approximately 80,000 gallons is not presently in service.

System Financing

The operation and maintenance of the Goldfield water system is paid for by a user charge set by the county. The current rate structure is as follows:

Residential Rate:

$1.50/100 cu ft up to 300 cu ft

$1.00/100 cu ft above 300 cu ft

Commercial Rate:

$2.00/100 cu ft 1st 100 cu ft

$1.50/100 cu ft next 1000 cu ft

$0.50/100 cu ft above 1100 ft

2. Near Future Water Supply

Since the current water supply, transmission and distribution system for Goldfield are inadequate and in need of replacement the county has applied for and received a grant and loan to upgrade portions of the system. The grant and loan obtained from HUD, State Water Planning, Four Corners Regional Commission and Farmer's Home Administration is for $1,300,000 to construct a new well, transmission line, and storage facility. The new supply is being designed to meet the current population demand with only a slight increase.

Supply

The new water supply for the town of Goldfield will be obtained from a well to be drilled 11.5 miles north of town. This well is to be located 700 feet west of an existing highway department well. The new well is expected to have a capacity in excess of 400 gpm. A water right application for the new well was filed with the State Engineer in February 1980.

New Supply Quality and Treatment

The new supply is expected to meet current State standards and not require treatment.

Transmission and Distribution

The grant and loan provide for an 11.5 mile transmission line from the new well site to existing storage and for a new 250,000 gallon storage tank. In addition, it is expected that some monies will be available to take care of the most serious problems in the existing distribution system. The county is also looking at a total rehabilitation of the distribution system in 1981, replacing existing small mains with 6 inch mains in order to improve the fire rating. The estimated costs of this replacement is approximately $500,000.

Financing

The 40 year loan for upgrading the present water supply system will be repaid from system use revenues, from gaming taxes and from an assessment fee. The county is planning to set up a special assessment district to obtain the latter. Any future work such as the distribution system replacement would be financed by a combination of grants and low interest l·ans.

3. Water Supply Expansion Capabilities

The current and near future water supply facilities for the town of Goldfield are based on current population with only a slight margin for increase. With the new town well and transmission line the supply capability will exceed current and near future demands but in order to be utilized additional pumping and storage capacity would have to be added to present plans. This potential expansion capability cannot be assessed until the final engineering report is completed on the transmission line design and the new well is drilled and test pumped. This report is due by the first of April and the new well is expected to be drilled in Summer 1980. The existing distribution system has very limited expansion capability due to its seriously deteriorated condition.

WASTEWATER FACILITIES

1. Existing System

Collection System

The existing wastewater collection system for the town of Goldfield consists of 4, 6 and 8 inch AC pipe. The system is in good condition with no serious problems. The gravity system is intercepted by an outfall line which continues northwest of town and discharges into a series of ponds.

Treatment

The wastewater treatment for the town of Goldfield consists of three settling, evaporation and percolation ponds constructed within the past ten years. No mechanical aeration is supplied. The ponds were designed to handle a population of approximately 1000 persons with no active discharge. There is currently some minor agricultural use of effluent from the third pond and mining companies have inquired about possible reuse of the effluent.

2. Near Future System

The current wastewater collection and treatment system for Goldfield more than meets existing and foreseeable near future needs. The system can adequately handle a population of 1000 persons, an increase of 600 over the current population.

3. Expansion Capability

Any expansion beyond the three ponds design population of 1000 persons would require a supplementary wastewater treatment system or an entirely new system at a new location. There have been no cost estimates made for a new system since the existing system has a capacity of 2-1/2 times current demand levels.

AUSTIN

GENERAL

The town of Austin is disincorporated and is governed by the Lander County Commission. The water supply and wastewater facilities are publicly owned and operated by the Lander County Combined Sewer and Water District Number 2 General Improvement District. The District is governed by five directors. The existing systems serve approximately 400 people and are financed through system generated revenue and a subsidy from the County. Neither the water supply nor wastewater systems are truly adequate to serve the existing Austin population.

WATER SUPPLY SYSTEM

1. Existing Water Supply System

Source

The existing water supply is taken from springs and wells located in Pony Canyon east of town and a spring in Marshall Canyon. The three wells, all approximately 350 to 400 feet deep, have reliable capacities of 20, 50 and 20 gpm These three wells are used alternately due to limited recharge in the area and large drawdowns.

The Pony Canyon spring is intercepted through a 500 foot horizontal well drilled in 1969 and produces approximately 15 gpm. The Marshall Canyon springs provide approximately 10 gpm.

In addition to the Pony Canyon wells and spring the town owns another well located three miles west of town in the Reese River Valley floor which is not connected to the existing supply system. This well is capable of producing approximately 500 gpm but the lift up to Austin is approximately 1000 feet which is not economical at the present time.

The water use in Austin is lower than most of the Nevada communities, being approximately 80-90 gpcd. Even with the low per capita demand supply problems exist. The existing supply proved to be inadequate during the summers of 1977 and 1978, requiring the town to truck water in from the valley.

The water rights to Pony Spring and the wells are held by the town of Austin.

Quality and Treatment

The quality of the Austin domestic supply meets State Water Supply Standards. A recent analysis is given below.

Austin

Sample Date: 11/6/79

TDS	259 mg/l	HCO_3	210 mg/l
Hardness	170 mg/l as $CaCO_3$	CO_3	0
Ca	50 mg/l	F	0.22 mg/l
Mg	11 mg/l	As	0.01 mg/l
Na	31 mg/l	Fe	0.22 mg/l
K	2 mg/l	Mn	0.08 mg/l
SO_4	43 mg/l	Color	3
Cl	14 mg/l	Turbidity	1.0 JTU
NO_3	0.5 mg/l	pH	7.9
Alkalinity	172 mg/l	Se	--

Chlorination is provided for the spring supply.

Transmission and Distribution

Water is transmitted from Pony Canyon to town via a 6 inch AC transmission main which was installed in 1970. In addition, a 3 inch PVC main transports water to the reservoir in town.

The distribution system in town consists of 6 inch AC, 3 inch plastic and 2 inch plastic and iron mains. New 6 inch mains have been installed down Highway 50 within the past eight years. Most of the distribution system is less than twelve years old and is in good condition.

Storage in the system consists of a 150,000 gallon steel storage tank installed near town in 1970, two small, 50,000 gallon rock and concrete reservoirs and a 20,000 gallon reservoir in Pony Canyon. The current fire rating for Austin is 10 which reflects on their ability with the present sources of supply and storage to provide adequate fire flows.

Financing

The existing water system operation and maintenance is financed through system generated revenue and a county subsidy. The current water rate in Austin is $0.85/1000 gallons. Improvements to the system within the past ten years have been primarily financed through grants and low interest loans from Farmer's Home Administration.

2. Near Future Water System

At the present time the Austin Water supply is not adequate for the current level of demand during dry years. The existing wells and springs above Austin are very sensitive to fluctuations in climatic conditions. The town has been attempting to phase out the use of the springs but the well system above town as it stands is not capable of meeting demand without the spring flow. The well below town could supply existing and even an expanded demand, but at present it is not economically feasible for the community to rely on that supply. In the immediate future there is not expected to be any major changes in the existing supply system.

3. Future Water System Expansion

As previously stated, the existing Austin water supply is not truly adequate to meet current demand. Any expanded demand would have to be met by new sources, most likely wells drilled down in the Reese River Valley with the water pumped up to Austin. Any increase in demand would require additional storage as well as an expanded water distribution system.

WASTEWATER FACILITIES

1. Existing Wastewater Facilities

Collection System

The Austin sewer collection system is composed of 6 inch AC collectors most of which have been installed within the past ten years. The collection system feeds into an 18 inch outfall line which flows by gravity to the treatment ponds.

Treatment

The existing treatment consists of two oxidation ponds southwest of town. These ponds, half-acre primary pond and a one acre secondary pond, do not meet State standards because of an active discharge to the dry wash. The existing system was completed in 1973 and financed through a 75 percent grant from EPA and a 25 percent Farmer's Home Administration loan.

2. Near Future Wastewater System

The existing treatment system with its active discharge to the wash is in violation of State standards. The State is asking that a third pond be constructed to provide for evaporation and percolation eliminating the active discharge of effluent. It is expected that the community will attempt to comply with the State standards within the near future.

3. Expansion Capability

The Austin wastewater treatment capability could handle expanded flows with relatively minor difficulty by expanding the oxidation pond system. Adequate land is available to provide a larger pond system. If the flows were to be significantly increased, it would most likely be desirable to provide mechanical aeration. The collection system would require expansion to accommodate new growth. Any significant growth would have to finance the system expansion since the community and county do not have the fiscal resources which would be required.

ALAMO

GENERAL

The community of Alamo has a population of approximately 900 persons. The town was primarily a farming community until a few years ago when mining activity in the area increased and the population increased from about 350 to the present. The town is unincorporated and is therefore governed by the Lincoln County Commissioners. The town operates with a Town Board and water supply and wastewater disposal are handled by a governing board of the Alamo Sewer and Water General Improvement District. Financial decisions are made by the board together with the county.

WATER SUPPLY SYSTEM

1. Existing

The existing water supply system was first constructed in 1947 with the aid of the Farmers Home Administration. Additions have been made in the past to expand service but the current supply is no longer adequate from the standpoints of quantity, storage and pressure. The system is fully metered and meters are read twice a year.

Supply

The current water supply for Alamo comes from four wells. These wells are all located in close proximity to one another on the west side near the high school. Wells number 1 and 2 were drilled prior to the installation of the water system in 1945 and have capacities of 100 and 60 gpm, respectively. These wells were drilled only five feet apart and share a common equipment building. Well 3 was drilled adjacent to Wells 1 and 2. Its capacity is approximately 100 gpm. The fourth well on the existing system was drilled in 1976 by Union Carbide Corporation to add to the limited supply when they began to move employees into Alamo for their mining activities. This well, 300 feet west of Wells 1 and 2, has a capacity of 200 gpm. During the peak summer use periods the wells run continuously to keep up with demand. Current water demand is approximately 48 mg/year.

The water rights for the Alamo water supply are as follows:

Groundwater Permit No.	Holder	Flow Rate cfs
30637	Union Carbide Corporation	3.0
31682	Alamo Farmstead Water Assn.	0.013
12898	Alamo Farmstead Water Assn.	0.133
39370	Alamo Sewer and Water General Improvement District	not specified

Water Quality and Treatment

The water supply does not meet recommended State Drinking Water Standards. The existing supply is high in TDS and hardness which causes some deposits in the distribution system. Currently there is no treatment to the water supply. A recent analysis of the Alamo supply is given below.

Sample Date 3/9/79

TDS	502 mg/l	HCO_3	427 mg/l
Hardness	297 mg/l as $CaCO_3$	CO_3	0 mg/l
Ca	48 mg/l	F	1.22 mg/l
Mg	43 mg/l	As	0.03 mg/l
Na	80 mg/l	Fe	0.02 mg/l
K	13 mg/l	Mn	--
SO_4	78 mg/l	Color	7
Cl	20 mg/l	Turbidity	0.2 JTU
NO_3	3.6 mg/l	pH	7.6
Alkalinity	350 mg/l	Se	--

Transmission and Distribution

The existing transmission and distribution system is composed of steel, AC and plastic pipe varying from 1 to 6 inches in diameter. Except for the newer areas of town to the southwest, the system is deteriroated and in need of replacement. Problems exist with low water pressures in the entire system and a lack of storage to meet peaking fire and other emerging requirements. The only storage at present is a 200,000 gallon tank to the west of town which doesn't provide adequate pressure.

System Financing

The existing water supply system has no debt to service and the water use charges are as follows:

$6.00/10,000 gallons

$0.50/for each additional 1000 gallons

2. Near Future Water Supply

Since the existing water system is inadequate for meeting peak demands in Alamo and exhibits low pressures, the town is in the process of upgrading the system both from a supply and transmission-distribution-storage standpoint. The Alamo Sewer and Water General Improvement District has applied for and received monies from Farmers Home Administration in the form of a grant, not to exceed $170,000 and a loan not to exceed $270,000. These monies are to provide a new groundwater source, new storage and extensive transmission and distribution system replacement during 1980. The design population used for the improvements is approximately 700 people, the current population served by the system.

Supply

The new water supply for Alamo will come from a well to be drilled 300 feet deep with a 10 inch casing located just south of First South Street on school district property near the track. The well is being designed to have a capacity of 600 gpm and will be the primary supply for the town. The District will retain well number 3 from the existing supply as a backup source. A groundwater permit application has been filed with the Nevada State Engineer for this new well. It is anticipated that once the new well is on line that Wells 1 and 2 can be retired. It is anticipated that the water quality from the new source will be better than the existing supply and meet the state drinking water standards. No treatment of water from this new well is anticipated at this time.

Transmission and Distribution

Included in the plans for 1980 upgrade of the Alamo supply are new 500,000 gallon storage tank to be located on a hill southeast of town. With the new storage tank the water pressure in the mains are expected to increase to approximateky 90 psi which will be adequate for fire protection. The existing 200,000 gallon storage tank will be retired from service.

Some 14,000 feet of transmission and distribution main are also included in the 1980 workplan. This will consist of primarily 8 inch main with some 6 inch. The line replacement has not gone out for bid at the present time.

Financing

As previously stated, the 1980 Alamo water supply system upgrade is being financed through a grant and loan from the Farmers Home Administration. Operation, maintenance and debt service will be paid from system revenues.

3. Water Supply Expansion Capabilities

The existing and near future water supply facilities for the town of Alamo are based on providing an adequate reliable supply for the current population with very little excess capacity. The new town well and storage tank are not being designed to accommodate any real growth. If the new well to be drilled is capable of supplying 600 gpm on a reasonably sustained basis, then any expansion of supply would be dependent upon providing additional storage within the system and additional transmission and distribution mains. There is currently a 54 lot subdivision being planned to the north of the existing town which could be connected to the updated supply.

WASTEWATER FACILITIES

1. Existing System

Collection System

The Alamo sewer system was constructed in 1975. The collection system is comprised of 4 and 6 inch plastic pipe. The collection system is in excellent condition. Effluent is pumped up to treatment ponds via a lift station located in the southwest portion of town.

Treatment

Wastewater treatment for the city of Alamo consists of three oxidation evaporation, percolation ponds located southwest of existing development. The wastewater treatment system has a designed capacity of 0.25 mgd or a population equivalent of 2500 persons at 100 gpcd. The system presently has 260 connections servicing approximately 900 people. At present there is no active discharge from the ponds and no reuse of the sewage effluent. The ponds are working adequately at the present time.

Financing

The existing Alamo wastewater collection and treatment system were financed through a grant and loan from Farmers Home Administration.

The loan was for $60,000 with a 40 year repayment period. The operation, maintenance and debt service are paid through a $6.25/month sewer use fee.

2. Near Future Wastewater System

The existing wastewater and treatment system were designed and built to serve a population of 2500 people. At present the system treatment capability far exceeds demand. But, there exists a limitation at the lift station. The existing pumps are nearing capacity and any substantial increases in effluent quantity will require replacement of the two existing pumps with larger pumps. Some consideration is also being given to adding an additional pond and mechanical aeration.

3. Expansion

Any expansion beyond the design population of 2500 would require total reconsideration of the entire treatment system. Expansion beyond the current level will require upgrading the lift station and may require some additional treatment.

CALIENTE

GENERAL

The community of Caliente is incorporated and is therefore self-governing. The water supply and wastewater facilities are owned and operated by the city. The city systems for both supply and wastewater disposal were first constructed in the 1930's to serve the city and the Union Pacific Railroad. The current population served is approximately 1000 persons with 425 water connections. The existing systems are for the most part adequate for current needs but some problems exist with respect to both supply and wastewater disposal. A master utility plan was completed in March 1979 which addressed both water and sewer systems making recommendations for improvements to each.

WATER SUPPLY SYSTEM

1. Existing

<u>Source</u>

Historically the water supply for Caliente has come from a number of wells many of which have since been abandoned due to either deteriorating water quality or insufficient production capacity. The current system is comprised of three wells. Well #8 located northeast of the school athletic field was constructed in 1966. This 195 foot deep well has a 14 inch casing and is capable of sustained production of 900 gpm. It is the primary source of supply at the present time. Well #9, constructed in 1970, initially produced significant flows but by 1977 began pumping sand and clogged. Attempts to restore the well by installing an engineered well screen were unsuccessful and the well is used only for backup with a capability of 125 gpm. The third well, Well #10, was constructed in 1978 and has a capacity of 900 gpm but also began to pump large quantities of sand and is not presently connected to the supply system. The city is considering operating both Wells #9 and #10 at low pumping rates as integral parts of the system. Current reliable capacity is 900 gpm with backup provided by the two newer wells. The current mode of operation is to pump directly into the transmission-distribution system with excess going to the two storage reservoirs.

The water rights for the Caliente supply are held by the city as follows:

Permit	Certificate	Flow (cfs)	Present Status
10662 (well #3)	3052	1.0	Abandoned
11582 (well #4)	3719	1.5	City Recreational Dept.
11581 (well #5)	3720	0.6	Abandoned
19377 (well #7)	5548	1.0	Abandoned
23933 (well #8)	8080	4.0	Active
25970 (well #9)	8076	2.0	Active (standby)
35583 (well #10)	--	3.0	No Proof (new well)

In addition to the city wells, there are several wells owned by Union Pacific Railroad which are not currently being used which could be leased to the city if the need arose.

Water Quality and Treatment

The Caliente water supply meets state drinking water standards. There have been past complaints about suspended solids and the water is moderately hard. The hardness has caused some deposition in the distribution system. Well #8 does exhibit high fluoride values, up to 1.45 mg/l. The following analyses are the most recent performed on the community supply.

Constituent	Concentration mg/l Well #8	Concentration mg/l Well #10
TDS	261	456
Harndess	168	186
Ca	54	53
Mg	8	13
Na	29	50
SO_4	4	22
Cl	15	20
NO_3	1.6	1.4
Alkalinity	190	232
HCO_3	232	283
Fe	0	0.38
Mn	0.01	0.07
pH	--	7.82
F	1.45	--

The supply receives no treatment at the present time.

Transmission-Distribution

The water supply transmission and distribution system today consists of nearly 9.5 miles of lines and two storage reservoirs. Total storage in the system consists of a 305,000 gallon concrete reservoir constructed in 1943 and a 500,000 gallon steel tank added to the system in 1971. The tanks are supplied when the well system is pumping in excess of demand.

The transmission and distribution lines serving Caliente consist of cast iron mains varying from 2 to 10 inches in diameter. The majority of these were originally put in in the 1930's when the system was first constructed.

The existing system does not have excessive maintenance problems, but is undersized in many areas with deteriorating lead joints. Dead end sections also cause stagnation and build up. It is desirable to rectify some of these problems by looping more of the system. The last significant upgrade was in 1971-72 which provided the new storage tank and 10 inch transmission line. The city has an active program of distribution system upgrade. The current fire rating for Caliente is 7.

System Financing

The Caliente water system is not metered on individual basis. The charges were set as follows in 1977:

Residential	\$8.50/month
Commercial	\$8.50/month plus \$1.00 per additional room or unit per month
Industrial (Nevada State Training School for Girls)	\$70.00/month

Of these amounts, \$4.00/month is to repay the \$50,000 loan used to construct well #10. A water connection fee of \$100.00 for new construction is also levied.

2. Near Future Water Supply System

The existing water supply system for Caliente is adequate to meet existing demands with some problems. The newest well, well #10, exhibits such severe sanding problems that it has not been connected to the existing system, leaving the city without adequate standby capacity. This problem will require attention in the near future. Other problems with the existing undersized water mains and continued growth to the north of town will require upgrading and expansion. Solutions to both of these problems are being actively pursued by the city. The city has recently submitted preliminary grant applications to HUD for approximately $250,000 to drill a new well and upgrade and expand the transmission distribution system in the northern section of town.

Supply

The city of Caliente is in the process of obtaining grant funds to construct a new well to replace well #10. It is expected that there will be little difficulty in obtaining a well which can produce approximately 900 gpm but the new well must be located and designed so that adequate quality is obtained and sanding problems are avoided.

Transmission and Distribution

The HUD grant application currently under consideration will allow for upgrading and expansion of water mains in the northern portion of town. No plans currently exist for major improvements to the rest of the transmission distribution system.

3. Water Supply Expansion Capabilities

The City of Caliente has available an adequate supply source and water rights to serve a population several times the size of the current population. It has been estimated that even with the high use rates (600 gallons per capita per day) that a population of 7300 people could be served. In order to achieve this it would be necessary to construct new wells or rehabilitate existing wells to their former production levels. In addition, there would be a need to provide significantly increased storage in the system to keep adequate pressure throughout and to meet fire flows. The u'ilities' master plan presents several alternatives to solve this problem together with recommendations for upgrading.

WASTEWATER FACILITIES

1. Existing System

Collection System

The existing wastewater collection system is comprised of nearly 6.5 miles of 4 to 12 inch vitrified clay and PVC pipe.

The major portion of the existing system was installed in the 1930's with sections of clay and PVC added as growth occurred within the service area. The system currently serves the entire town.

The wastewater collection system is separate from storm drainage and is in generally good condition. Problems occur where undersized lines, inadequate grades and/or tree root penetration limit line capacity. These problems are generally with the 4 and 6 inch lines which should be replaced with 8 inch minimum. There appears to be some infiltration into the collector system which increases the hydraulic loading at the treatment plant.

Treatment

The existing sewage treatment facility, constructed in 1972, is an extended aeration activated sludge plant. The plant consists of grit removal and comminutor equipment followed by extended aeration, primary clarification, chlorination and secondary clarification. Activated sludge solids from the primary clarifier are recycled to the aeration tank. Stabilized sludge is pumped to drying beds. Effluent from the secondary clarifier is discharged to Meadow Valley Wash.

The Caliente treatment plant was designed with a hydraulic capacity of 0.4 MGD which is adequate to serve 3200 people at 125 gpcd. The present sewage flows average less than 0.25 MGD with high flows in excess of 0.7 MGD having been recorded during storm periods. Excessive stormwater runoff enters the system through manholes. The influent sewage includes considerable volumes of fresh water entering the collector system from infiltration, leaking plumbing fixtures and discharge of water cooled compressors. This excess hydraulic loading is reflected in the weak character of the plant influent, approximately one-half of medium strength domestic sewage.

The existing treatment train is adequately serving the city of Caliente. It is well below hydraulic capacity but does not meet the effluent discharge standards put forth in Caliente's NPDES permit. The standards are as follows.

Caliente

Discharge Limitations

	Kg/day 30 day Avg.	#/day Daily Max.	30 day Average	Daily Max.
BOD 5 day 20°C	45(100)	68(150)	30 mg/l	45 mg/l
Suspended Solids	45(100)	68(150)	30 mg/l	45 mg/l
Settleable Solids		0.1 mg/l	0.2 mg/l	
pH		not less than 6.0 nor more than 9.0		
Fecal Coliform Bacteria			200/100 ml	400/100 ml
Flow		0.4 MGD		

At the present time there is no reuse of the Caliente wastewater treatment plant effluent, although there is some potential reuse.

Financing

The current use fees are a flat rate of $3.50/month with a $125.00 connection fee. These fees are set by the city to pay operating and maintenance for the wastewater collection and treatment.

2. Near Future Wastewater System

The existing system was designed for a population several times the existing population. It may be necessary to upgrade certain individual processes to comply with NPDES standards. There needs to be some improvement in the collector system in the north end of town since the lines are undersized and have difficulty handling the recent growth in this area.

The Utilities Master Plan makes several recommendations concerning the overall wastewater system in order to accommodate future growth as well as meet NPDES standards. These recommendations are:

Collection System

Replace undersize clogging lines with a minimum 8 inch line. Implement a yearly cleaning program.

Sewage Flows

Immediately implement a program to fix all leaky plumbing fixtures and prevent extraneous flow into the system. Consider metering water connections. A water conservation program should be implemented to educate the residents of Caliente on the need for water conservation, and techniques to conserve water.

Meeting Effluent Requirements

Upgrade treatment plant laboratory facilities. Obtain instruction for operation in use of lab analyses for process control.

Treatment Plant

Reattach primary clarifier weir. Stabilize slopes around the secondary clarifier and influent works. Convert the present sludge holding tank into an aerobic digester.

The approximate cost estimates for these improvements are $125,000.

3. Expansion

Any expansion beyond the design capacity of the existing wastewater treatment system would require a total reconsideration of the treatment train and effluent disposal practice. Serious consideration should be given to reuse of the plant effluent.

PANACA

WATER SUPPLY

Existing

The Panaca water supply is owned and operated by the Panaca Framstead Association made up of the subscribers to the system. The existing system constructed in 1943 is supplied by two wells, one constructed in 1953 and a second well constructed in 1965. Both wells are approximately 180 feet deep and are capable of producing in excess of 1000 gpm. The wells are equipped with considerably smaller pumps. The newest well with a 250 gpm pump is presently used as a primary supply; the other well is a standby. The current system serves a population of approximately 725 people with an average use of 290 gpcd and peak use of 350 gpcd.

The distribution system is comprised of 3 to 6 inch mains most of which are over 25 years old and somewhat undersized. The storage in the system is comprised of two 0.05 mg wood storage tanks which are not adequate. The supply system suffers from low pressures during the high demand summer months.

There has been a recently completed study of the Panaca system which examined the existing system and made recommendations for upgrading and providing expanded service.

The Panaca water supply is of adequate quality and meets State Drinking Water Standards. The supply has a high fluoride content.

Future

The existing Panaca water supply system is not adequate for existing population due to inadequate storage and distribution main size. The current water right, 450 gpm, and wells should be capable of supplying a population of 2000 provided the system is upgraded with respect to storage and distribution. The recently completed engineering study recommended the following upgrades to serve 2000 population.

1. Upgrade transmission to 8 inch mains;
2. Add 0.5 mg reservoir;
3. Add 8 inch line from new storage to distribution system.

These proposed upgrades are estimated to cost approximately $500,000. The town would require substantial outside financial assistance to implement these recommendations. Any expansion beyond the current water supply water right would require the Association to develop supplemental sources as well as other engineering works.

WASTEWATER

Existing

The existing Panaca waste treatment facilities were put into service in 1974. The system consists of primarily 6 and 8 inch collectors which is discharged east of town to a series of three oxidation ponds. There is currently no reuse of the effluent and generally no active discharge from the ponds. There can be overflow from the third pond at times of heavy flow. The only problem with the existing system is an odor nuisance. The current system is designed to serve 600 people.

Future

The existing collection and treatment facilities for Panaca are adequate for the current levels of demand. The odor problem could be alleviated by providing mechanical aeration to the primary pond. The system could handle an increase in population by adding to the current pond system. If there were to be greatly increased demands on the wastewater facilities, an active reuse concept may have to be implemented to meet state standards together with a revised treatment train.

PIOCHE

GENERAL

Pioche is an unincorporated community which is governed by the Lincoln County Commissioners. The water and sewer systems are owned and maintained by the town under the name of Pioche Public Utilities. The existing systems serve approximately 700 persons including the Caselton area. The original water system was constructed by the Amalgamated Mining Company and later purchased by the town. The town recently completed a water study and is in the process of upgrading the entire water supply system.

WATER SUPPLY SYSTEM

1. Existing System

Source of Supply

Water for the Pioche-Caselton area is derived from one spring and three wells. The spring is located 5 miles southwest of Pioche and is primarily used to supply the demand of approximately 50 residents in the Caselton area. The spring which flows between 35 and 70 gpm is under a 99-year lease from Amalgamated Mining to Combined Metals. The main supply for Pioche itself comes from three wells, all located north of town. The original town well, #1, approximately 1/2 mile north of town, is capable of producing only 100 gpm and is the oldest, having been drilled in 1935 and deepened in 1961. This well is essentially abandoned and not being used in the system. Well #2, 2-1/2 miles northeast of town is 500 feet deep and has a capacity of 175 gpm. It is used as a standby for the system. The third well, Well #3, drilled in 1966, is the main source of water for the town. It is located approximately 1600 feet northeast of Well #2 on the flat northeast of town. This well produces 350 gpm. The water rights for these sources of supply are as follows:

Certificate No.	Owner	Flow Rate CFS
3179	Amalgamated Pioche Mines & Smelter	0.15
8026	Pioche Public Utilities	0.78
8027	Pioche Public Utilities	0.39

The total public water right is for 594 gpm. In 1977 the water usage was as shown below:

	Pioche	Caselton
Population	640	50
Average annual use	25.49 mg	8.7 mg
Average annual gpcd	109 gpcd	477 gpcd
Peak month use	3.44 mg	0.9 mg
Peak month gpcd	1.79 gpcd	662 gpcd

Quality and Treatment

The Pioche water supply meets state drinking water standards, but has a hardness in excess of 300 which causes problems in the distribution system. An analysis of the Pioche public supply is presented later.

The Pioche water supply receives no treatment.

Transmission and Distribution

The transmission line from Well #3 to Well #2 is 6 inches wrapped stell pipe and the main from Wells #1 and 2 into town is 8 inches. These mains are in good condition. The 5 mile 4-1/2 inch transmission main from Floral Springs is in poor shape and scheduled for replacement in 1980.

The distribution system is a high pressure system with pipe sizes ranging from 1-1/2 to 6 inches. Each residence has a pressure reducer. The entire distribution is scheduled for replacement in Summer 1980 with 6 inch lines.

The existing system contains 211,000 gallons of storage. Water is pumped from Wells #2 and 3 to the tank from a booster station 1/4 mile northeast of town. The booster station is equipped with one 375 gpm pump and one 150 gpm standby pump.

Financing

The water supply charges are currently set to provide for operation and maintenance costs of the system. The existing rates were set in 1940 as shown below. The existing system has approximately 30 percent of the connections not metered. The rehabilitation in Summer 1980 will provide for a totally metered system.

Pioche Water Rate Structure 2/80

$5/month for 6000 gallons

$0.35/1000 gallons for next 10,000 gallons

$0.25/1000 gallons over 16,000 gallons

Any major changes to the system require funding outside the existing use fee.

2. Near Future Water Supply System

The community of Pioche had a study of the water system performed in 1978 funded by the Four Corners Regional Commission. That study made several recommendations which are currently being pursued.

The following is the basis for the 1980 water system upgrade.

Future Water Use

	Pioche	Caselton
Design population	650	50
Annual demand	26 mg	8.7 mg
Average annual gpcd	109 gpcd	480 gpcd
Peak month	3.5 mg	0.9 mg
Peak month gpcd	180 gpcd	662 gpcd
Fire flow	500 gpm - 4 hrs	500 gpm - 4 hrs

A comparison of this criteria with current usage shows essentially no provision for expansion in the recommended system upgrade. The improvements to be made in Summer 1980 are as follows:

1. Replace entire distribution system with 6 inch mains.
2. Replace transmission main from Floral Springs.
3. Replacement of storage tank covers for the Caselton tank and the 211,000 gallon Pioche tank.
4. Rehabilitate Well #2.

The above list of improvements is to be financed with $350,000 obtained partially as a grant and loan from the Farmers Home Administration. At the Present time, items 1 and 2 are within the financial capability with some doubt as to available monies for items 3 and 4.

Financing the water supply improvements is predicated on the existing demand and will require a change in the existing rate structure. The recommended new rate structure is as follows.

Present minimum	$5.00	
Debt retirement	2.70	
Increased O&M	1.05	
	$7.75	for first 6000 gal/month

The declining block rate would be the same as the present rate.

3. Further Water Supply System Expansion

The existing Pioche water supply system has essentially no excess capacity. The upgrade to be accomplished in Summer 1980 is designed on the basis of providing more reliable supply but does not provide for any increased demand. In order to satisfy any significant increase in demand, the Pioche water supply system would require at a minimum a significant increase in storage and an upgrading of the well system, specifically rehabilitation of Well #2 and possibly an additional well with capacities equivalent to that of Well #3. A rough estimate of the cost of a new expanded water supply system provided by Pioche Public Utilities is $622,000. Any new growth would primarily take place outside the existing town limits and would have to provide its own utilities which would then hook up to the Pioche Public Utilities system.

Wastewater Facilities

1. Existing Facilities

Collection System

The existing collection system was built in 1945 and 1946 with significant additions in 1954-1955. It consists of VC pipe and is in good shape. The pipe sizes and relatively steep grades provide more than adequate capacity for the existing town. The entire collection system is gravity flow.

Treatment

The existing Pioche wastewater treatment facility was constructed in 1968 using a design population of 1500. The currently served population is less than 700. The facility consists of a 10 inch outfall line, a 15 foot deep mechanically aerated pond with two stationary aerators and two evaporation percolation ponds in series. The system provides adequate treatment for the existing population with few operational problems other than aeration and is not used during winter months due to ice buildup. There is no active discharge from the facility.

Financing

The current sewer use fees are $2/month for residential use and $6/month for commercial establishments. These fees are set to provide operation and maintenance on the existing facility.

2. Near Future Water Supply System

The existing wastewater treatment facilities have the capability of serving 1500 people, over twice the current demand. There are no serious problems with either collection or treatment; therefore no changes in the system are planned at the present time.

3. Future Expansion of Wastewater Facilities

The existing treatment train can handle a doubling of the current population before reaching capacity. Any population increase beyond the 1500 population level would require additions to the existing plant, perhaps increased aeration and certainly an increase in the evaporation percolation pond size to ensure no active discharge occurs. Any increase in population will require expansion of the collection system. As with expansion of the water system, new developments would have to provide their own sewage collection system and tie into the existing Pioche Public Utilities system.

Pioche Public Water Supply

Sample Date: 11/15/77

TDS	302 mg/l	HCO_3	366 mg/l
Hardness	327 mg/l as $CaCO_3$	CO_3	0
Ca	73 mg/l	F	0.14 mg/l
Mg	35 mg/l	As	0
Na	4 mg/l	Fe	0.06 mg/l
K	0 mg/l	Mn	0.02 mg/l
SO_4	8 mg/l	Color	3
Cl	5 mg/l	Turbidity	0.1 JTU
NO_3	2.2 mg/l	pH	7.88
Alkalinity	300 mg/l	Se	--

TONOPAH

GENERAL

The town of Tonopah is located in south central Nevada on the western slopes of the San Antonio Mountains. The town is not incorporated and is governed by the Nye County Commissioners as the Board of Trustees. The water and wastewater facilities are owned and maintained by the town of Tonopah under the Tonopah Public Utilities.

The original water system for the town of Tonopah was constructed in 1903 with major improvements consisting of replacing and adding to the original system. The current water system supplies a population of approximately 2700 persons with the population expected to reach 5000 within the next few years due to increased mining activity in this part of the state. There are 909 present residential water hookups and 108 active commercial hookups. The average residential usage is 5740 gallons/month and the water system is fully metered.

The water supply was substantially improved approximately 10 years ago to improve fire flows. No current plans exist for substantial expansion of the water supply capability.

The existing sewer and wastewater treatment facility no longer meet the community needs nor State standards. At this time a new sewage treatment facility is being designed which will have the capability of serving a population of 5000 people.

WATER SUPPLY SYSTEM

1. Existing

<u>Source of Supply</u>

Tonopah is supplied from the Rye Patch well field located some 16 miles north-northwest of town in Ralston Valley. The well field, constructed at the site of a natural spring discharge area, contains 6 wells, 5 of which are in use at the present time. These wells are all drilled to approximately 300 feet with the producing zone between 8 and 80 feet. Four of the wells were previously tested in 1966 and, together with the newest well, would have a capacity in excess of 900 gpm. The firm sustainable pumping capacity of the well field is unknown at the present time but pump tests are planned for summer 1980.

At the present time pumping records show no interference among the wells and little change in water levels in the well field from year to year which indicates that the present and historic use is not overtaxing this source of supply.

The water rights for the Rye Patch source are held by the town of Tonopah. Their current rights are:

Permit Number	Certificate Number	Flow Rate cfs
	01597	0.926
11171	2945	0.37
11172	2867	1.2

Quality and Treatment

The water supply quality meets State standards. A recent analysis is given below.

Tonopah

Sample Date: 1/10/78

TDS	260 mg/l	HCO_3	122 mg/l
Hardness	110 mg/l as $CaCO_3$	CO_3	0
Ca	39 mg/l	F	0.34 mg/l
Mg	3 mg/l	As	0.005 mg/l
Na	27 mg/l	Fe	0.01 mg/l
K	6 mg/l	Mn	0
SO_4	35 mg/l	Color	3
Cl	14 mg/l	Turbidity	0.1 JTU
NO_3	14.7 mg/l	pH	7.72
Alkalinity	100 mg/l	Se	--

At the present time there is manual chlorination of the community water supply.

Transmission and Distribution

The water from the well field is pumped through 2 miles of 8 inch steel pipe to a 78,000 gallon tank at Rye Patch booster station. The booster station is equipped with two 75 hp pumps each rated at 500 gpm which pump from the tank through 6 miles of 8 inch steel pipe to a 120,000 gallon reservoir at booster station #2. The two pumps at booster station #2 are 75 hp driven by electric motors and rated at 500 gpm each. These units pump from the 120,000 gallon reservoir through 5 miles of 10 inch AC and steel transmission main to a 235,000 terminal storage reservoir above town. The transmission mains from Rye Patch to the terminal reservoir were replaced in 1960 and are in good condition. The transmission system is capacitated by the 8 inch line and the pump capacities of 500 gpm. At present the booster pumps operate approximately 50 percent of the time.

Water from the terminal storage tank flows by gravity through 2-1/2 miles of 12 inch steel transmission main to 2-500,000 gallon covered steel storage tanks which were added to the system in 1971. Water by gravity feed from the terminal storage is supplied through 2 miles of 14" steel transmission main to the downtown area encompassing approximately one-half of the town. The remainder of the town is supplied by two additional reservoir systems and booster pumps, as shown below.

Pumped to 2nd level		500,000 gallons
	Mizpah Hill	78,000 gallons
	Sandia Hill	312,000 gallons
	Bryan St. Booster	240 gpm
Pumped to 3rd level		30,000 gallons
	Above Sandia Housing	20,000 gallons
	Military Circle	80,000 gallons
	Sandia Housing Pump	110 gpm
	Military Circle Pump	120 gpm

The original water distribution system mains range in size from 2 to 10 inch a d are constructed of every type of pipe. A major improvement was undertaken during 1970 and 1971 which installed some 16,400 feet of new 6 and 10 inch feeder mains and 12 new fire hydrants. Since that time other improvements have been made by replacing badly deteriorated and undersized mains. At the present time the system has no serious problems.

Financing

The entire water supply for Tonopah is on a metered system with rates set by the town to cover operation and maintenance costs. The current rate structure is presented below.

Residential

$3.50 first 1000 gallons

$2.40/1000 gallons for next 3000 gallons

$2.20/1000 gallons for next 5000 gallons

$2.10/1000 gallons for next 9000 gallons

Commercial

$5.00 first 1000 gallons

$2.80/1000 gallons for next 3000 gallons

$2.70/1000 gallons for next 6000 gallons

$2.00/1000 gallons for next 90,000 gallons

$1.75/1000 gallons for next 200,000 gallons

2. Near Future Water System

The existing water supply system for Tonopah is adequate to meet the current needs. There are no active plans to make any major changes to the system at the present time other than to incorporate new growth into the existing system. At the present time the increased mining activity is causing Tonopah to grow. The largest new development is that planned by Anaconda Copper Corporation which has a new mine northeast of Tonopah. In conjunction with this operation the company is developing a major subdivision including single family, multi-family, and modular homes. The total impact of this development is expected to be 2000 to 2500 new people. The development will install its own transmission and distribution lines but will tie into the existing Tonopah water supply. At the time the development is built, expected to be in late 1981 or 1982, the existing water supply facilities will be fully utilized.

In addition to this new development there has been a proposal to develop an industrial park at the airport site in Ralston Valley. If this project moves ahead in the near future it will need a source of water which most likely would come from the Rye Patch well field and be transmitted to the industrial park via a separate line.

Supply

The existing well field at Rye Patch in Ralston Valley is expected to be able to adequately supply the added demand due to Anaconda's activity. There are no active plans to develop additional supply sources but some well testing is planned for summer 1980 on the existing wells to better estimate the field's supply capability. If the industrial park at the airport proceeds, the town may turn over one or two of the smaller producing wells at the Rye Patch field to supply that development and drill one or more new wells in the Rye Patch field.

Transmission and Distribution

All new lines associated with the Anaconda development will be put in by the developer and deeded over to the town. Any transmission lines for the airport industrial park development will be separate from the Tonopah system and probably will be the total responsibility of the developer. The existing transmission system from Ralston Valley is adequate to handle the population increase due to the Anaconda development. The system is capacitated by the existing pumping equipment but is expected to be able to meet the increased demand by higher utilization of existing equipment. Some of the pumping equipment is old and may have to be replaced, especially if there is increased pump use. Storage in the Tonopah water system is more than adequate to meet the near future demand. The large amount of storage carries over from 10 to 15 years ago when power to the community would be out for 3 and 4 days at a time during the winter.

3. Future Water Supply Expansion Capabilities

Once the Anaconda development is complete the Tonopah water supply system will be fully taxed with 5000 people served and any demand beyond that will require major changes to the system. The transmission system would have to be upgraded by a) installing new larger capacity pumps at booster stations #1 and #2 and/or b) installing parallel transmission lines and pumping facilities to bring additional water from Ralston Valley.

At the present time there is also very little known about the capability of the Rye Patch well field supplying quantities of water that would be needed for development beyond that already underway. If that source is not capable of meeting increased future demands then additional sources will have to be developed. In the immediate area around Tonopah there does not appear to be any new unexploited source of water which meets domestic use quality requirements.

WASTEWATER FACILITIES

1. Existing

Collection System

The community of Tonopah is sewered by gravity laterals and lager collector sewers running northerly through the center of town. There are presently 767 residences and commercial establishments connected to the collection system. There are a number of residences which are served by town water but not by the sewer system. The collection system is of varying age and condition. The collection system terminates in an outfall 1.4 miles northwest of town below the town cemetary in Esmeralda County.

Treatment

The present treatment is provided in two unsealed raw sewage oxidation ponds. These ponds are built on quite pervious soil and do not provide adequate treatment. There is presently some temporary aeration being provided as a stop gap measure until a new treatment system under design can be brought on line.

Until the new expanded treatment facility is operable there is an unofficial sewer hookup moritorium. One new motel is building a small package plant and attempting to get a State discharge permit.

Financing

The fees are set by the town to pay operation and maintenance costs for wastewater collection and treatment. They will most likely be changed in the near future to repay the local portion of the new system.

2. Near Future Wastewater System

Since the present sewage treatment system doesn't meet current demand and State standards, the town of Tonopah has applied for a construction grant to improve the current system.

The project is estimated to be financed $666,000 from EPA and $222,000 as a local share and will include the following three items.

1. Construction of 4300 feet of 15 inch gravity outfall line for conveyance to the new site.
2. Construction of 0.5 MGD wastewater treatment facility consisting of headworks, Imhoff tank, percoloation ponds, and sludge drying beds.

3. Construction of approximately 6,140 feet of new collection lines.

It is anticipated that the project will be under construction by late summer 1980.

The design capacity of the project will be adequate to serve 5000 people or an increase of approximately 2200 over current levels. At the present time it is not known whether the new Anaconda development will tie into the expanded town wastewater facilities. The Anaconda development is currently examining alternatives to tying into the town system. If this development does connect to the new treatment facility, then it will reach capacity within a year or two of completion.

3. Future Wastewater System Expansion Capabilities

The new treatment system to be built in the latter part of 1980 will have an initial excess capacity capable of serving approximately 2200 persons. If the Anaconda development does not connect to the town system this capacity will be available to satisfy other future growth. If Anaconda does tie into the town system then the new treatment plant will be at capacity very soon after completion.

The town has no plans to expand its treatment facility beyond the 0.5 MGD level. Any expansion beyond this new facility would require a complete rethinking to include the collection system also. One problem area which must be considered with any expansion is that the area to which the gravity system drains and in which the existing, the new and most likely any additional treatment systems are constructed is in Esmeralda County and not Nye County.

ELY

GENERAL

The city of Ely is incorporated and self-governed. The water system is owned and operated by the Ely Municipal Water Department which is administered by an appointed three-man board. The wastewater collection and treatment systems are also owned and maintained by the city of Ely. The city employs a city engineer and has an active program of maintaining and upgrading both the water supply and wastewater systems. At the present time the systems serve a population slightly in excess of 6000 people and both have the capability of meeting increased demands with some relatively minor improvements.

The city of Ely has a class 5 fire rating.

WATER SUPPLY SYSTEM

1. Existing Water Supply System

<u>Source of Supply</u>

The sources of supply for the community of Ely are Murry Springs west of town and two municipal wells. Murry Springs has historically supplied the majority of domestic supply for the city. The springs flow have reduced from an average flow in 1970 of 10.15 cfs to 4.65 cfs during 1979. The decline in spring source is currently of considerable concern to the city. In addition to Murry Springs, the city operates two wells for supplemental and peaking purposes. The wells are not used during the winter season. The 10th and "M" well with a 1000 gpm yield is used during the summer to supply the East Ely pressure zone. The North Street well with a 950 gpm yield is used as a supplemental source for the rest of the system during the summer. The groundwater usage has varied considerably in the last few years from 202 mg in 1976 to 80 mg in 1979. The existing supplies are adequate to meet current levels of demand in Ely even with the high 350 gpd use rates.

The water rights to Murry Springs and the two wells are held by the city. These rights are:

Groundwater Certificate No.	Holder	Flow Rate cfs
2512	Ely Water Company	0.67
5598	Ely Municipal Water Department	2.0
7230	Ely Municipal Water Department	2.0
9161	Ely Municipal Water Department	2.0
Surface Water		
Murry Springs	Ely Municipal Water Department	11.0

Quality and Treatment

The municipal water supply for Ely meets state drinking water standards. The spring collector system is totally underground so there is little chance of contamination of this supply. The spring supply is chlorinated. The existing water supply chemistry is given below.

Sample Date 10/19/77

TDS	179 mg/l	HCO_3	173 mg/l
Hardness	163 mg/l as $CaCO_3$	CO_3	4 mg/l
Ca	34 mg/l	F	0.19 mg/l
Mg	19 mg/l	As	0 mg/l
Na	6 mg/l	Fe	0 mg/l
K	2 mg/l	Mn	0 mg/l
SO_4	0 mg/l	Color	3
Cl	5 mg/l	Turbidity	0.2 JTU
NO_3	2.7 mg/l	pH	8.11
Alkalinity	150 mg/l	Se	--

Transmission and Distribution

The transmission and distribution system in Ely is adequate and functional. The city maintains an active program to maintain and upgrade all lines. A 16 inch line from Murry Springs collector transmits water from the spring source to the Murry Booster Station and into the city distribution system. A 12 inch main on East Campton Street serves East Ely. The remainder of the system consists of 31 miles of 10 to 4 inch feeder mains.

Storage in the system presently totals 6.05 mg with an additional 1.5 mg being planned. This storage consists of a 2 mg tank located off the Highway 6 bypass constructed in 1976, 2 tanks above the courthouse totaling 2.5 mg, a 1.5 mg tank northwest of the railroad tracks which was added to the system in 1978. There is also a small 0.05 mg tank for the Elysium Terrace area which will be taken out of service as soon as some modifications are made to connect the Highway 6 tank to the Indian Colony.

Financing

The Ely water system is financed by system revenues for operation and maintenance. Major system improvements have largely been financed through grants together with local monies. The system is unmetered for residential use and use charges are a flat rate. The residential rate is $6/month plus $.40/100 square feet of lawn as a once a year summer surcharge. Commercial customers are metered and charged on a declining block rate. This rate is as follows:

$10/month for first 15,000 gallons
$0.45/1000 gallons for next 10,000 gallons
$0.40/1000 gallons for next 25,000 gallons
$0.30/1000 gallons for next 50,000 gallons
$0.20/1000 gallons for next 100,000 gallons
$0.10/1000 gallons for over 200,000 gallons

The operational costs of the system are fairly low since most of the system is gravity fed.

2. Near Future Water Supply System

In general the Ely water supply system is in good condition and capable of meeting existing and expected near future demands. But the city is concerned with maintaining a reliable supply and supply system so it is actively planning improvements in several areas.

Supply

The existing sources of supply, Murry Springs and the two wells, are more than adequate to meet current levels of demand, but the town water board is concerned with the Murry Spring supply. The springs have exhibited a steady decline in production over the past 10 years with current flow being less than one-half the flow of 10 years ago. The board recently asked their engineering firm to look at the supply and water needs which might result from rapid growth. The findings of that study were reported in "Ely Water Supply Analysis for the Ely Municipal Water Board" by

Chilton Engineering. These are as follows:

"A. WATER DEMAND

1. It is recommended that all existing residential units be provided with water meters and a metered rate be put into effect at such time as all units are metered.

2. Meter installation should be required on all new construction.

3. Constant or increasing block rates should be put into effect to encourage conservation. Decreasing block rates are not requiring a "fair-share" payment by high volume users.

B. WATER MANAGEMENT

1. All water rates and production costs should be analyzed to insure a profitable water enterprise.

2. Hookup and connection charges should be put into effect and/or increased to cover tap costs and require new units to bear the cost of storage and supply needs caused by new developments through the connection charge revenues.

3. Main extension policy must be carefully reviewed to require developers to bear the cost of mains larger than the present policy dictates in order to meet future needs.

4. A new master plan for the water system must be coordinated with plans developed by the City, County and Regional Planning Commission. Water needs, along with sewer and other utilities, should have a large impact on the planning for rapid expansion of Ely.

5. Policy should be established to require payment to the Water Department for all water used on City-owned lands (i.e. parks, cemetary, etc.) at an established metered rate. This should be implemented so as to insure visible fiscal responsibility on the part of the Water Department in securing future financing. This requirement will also prevent unrestricted City water consumption costs in planning new areas which require lawn or other irrigation.

C. WATER RIGHTS AND SOURCES

1. The City of Ely should file approximately 13 applications to appropriate underground waters with the State Engineer as soon as possible. In order to prepare for the maximum projected population of 50,000 by 1995, the City would have to provide an average of 6,483 mg/yr., based on 355 gallons per capita per day. This type of demand would require approximately 13 wells producing 900 gpm each, for average flows and possibly 18 additional wells at that rate to meet peak demand days.

2. There is a possibility that utilization of the water flowing into the unused Kennecott pits at Ruth may provide a reliable source of potable water. Quality and quantity should be checked to see if the source could be used and what treatment would be required. Records of water level should be developed and a cross-check with Murry Spring flow should be made to determine any interrelated effects. An agreement may be made with Kennecott to provide water from the source to supply Ruth as well as Ely, since Ruth will also experience growth and increasing demands for water. Improvement of their collection system will become necessary in order to meet these needs. It has been reported that the Ward Mountain Collection System is in need of major maintenance and upgrading.

3. Existing water rights on lands near Ely for irrigation should not be discounted. Future water demands can be met by the purchase of underground irrigated acreages located in the Steptoe Valley Basin. When the demands necessitated, these acreages could be dried up and the well, or water use, transferred to a location that could be utilized by the Ely Municipal Water System.

4. The artesian well on the Georgetown Ranch should be considered as a possible future source of municipal supply. By changing the manner and place of use of this artesian water to the City potable system, additional water would be available to Ely."

Source - "Ely Water Supply Analysis for the Ely Municipal Water Board," Chilton Engineering, February 1980.

These latter recommendations reflect directly on the concern over diminshed Murry Spring supply. The board is acting on the recommendation to file for additional groundwater. The other source of future supply considered, the water in the Ruth pit, is not of acceptable quality for domestic use.

Transmission and Distribution

The city of Ely maintains an active program of system replacement and upgrade. There are several significant improvements or changes actively being pursued at the present time. These include increased storage, line replacement, and development of new supplies.

The 1978 Improvement Plan for the City of Ely includes two major system improvements. The first is the construction of a new 1.5 mg storage tank and Murry extension which would be supplied from Murry Springs.

The second would be to tie the 2 mg Highway 6 storage tank into the Indian Colony and retire the 0.05 mg Elysium tank. The costs of these improvements will be approximately $726,000. The city is seeking federal funds from HUD for these improvements.

In addition, there are main replacement and addition of fire hydrants planned for 1980.

3. Further Water Supply Expansion Capabilities

The city of Ely with its engineering consultants have just considered the demands of rapid growth on the water supply system. The water board is moving forward to acquire additional groundwater supplies to possibly replace the diminishing Murry Springs supply and to supply future growth up to a maximum population of 50,000. No detailed considerations have been made of the other engineering works which would have to be constructed together with the new wells to meet such a demand.

WASTEWATER FACILITIES

1. Existing

Collection System

The sewage collection system for Ely is operated and maintained by the city of Ely. The system includes both the Ely and the old East Ely Sanitation District which served the East Ely area prior to being annexed in 1975. The collection system consists mainly of 6 and 8 inch VC pipe. The Ely portion has been constructed over the past 75 years and the East Ely portion constructed in 1954. The existing system is more than adequate to handle existing and expected near future demands. The system has three flush tanks in operation at the present time.

The existing collection system does experience severe infiltration due to deteriorated bituminous joints throughout the Ely portion of the system. The newer East Ely area does not exhibit high infiltration. The collection system also picks up considerable volumes of storm water during wet weather conditions. The city is actively working to separate the storm water from the sanitary system.

Treatment

Treatment is provided at a plant located north of Ely adjacent to the Georgetown Ranch. This plant, constructed in 1967 uses extended aeration followed by oxidation ponds. The ponds have a 14 acre surface area. The existing plant capacity is 1.8 mgd with current use level being 1.1 mgd. The city of Ely does have a NPDES permit for discharge into Murry Creek but at the present time there is no active discharge to the creek. The NPDES requirements are as follows:

	Discharge Limitations			
	30 day Average	Daily Maximum	30 day Average	Daily Maximum
Flow			$0.08 m^3/sec$	$0.12 m^3/sec$
BOD	204 Kg/day	460 Kg/day		
D.O.	not < 3.0 parts at any time			
Fecal			200/100 ml	2000/1000 once/month

The treatment train is more than adequate to meet present demands, although it operates at a low efficiency due to the dilute character of the influent. A reduction of infiltration to the collection system would reduce the hydraulic plant loading and help improve plant efficiency.

Financing

The operation and maintenance of the sewer collector and treatment are financed through $2.00/month sewer use fee. Any significant improvements are funded through grants-in-aid or other general funds.

2. Near Future Wastewater System

The Ely wastewater system is more than adequate for current and near future needs. The treatment system should be able to serve a population of 18,000 persons using 100 gpcd sewage flows. The existing sewage flows are 183 gpcd which reflects the large amount of fresh water getting into the collection system through infiltration and the use of flush tanks. The city is planning to eliminate the flush tanks and eliminate the high infiltration in the near future. The costs for these two improvements is estimated to be $700,000.

The city is also actively working on the other problem associated with the existing wastewater system, that of storm water. Steady improvements to the storm drain system are being made with $144,000 spent in East Ely last year and another $100,000 scheduled for this year. The major flood producing area of Murry Canyon would cost approximately $1,000,000 to effectively control.

The city has also considered reuse of the effluent on the city owned Georgetown Ranch to eliminate discharge to Murry Creek in the future as sewage flows increase.

3. Further Wastewater Facility Expansion

The city of Ely has no current plans for expanding either the collection system or treatment system. The treatment system as presently sized and configured can serve a population of 2 to 3 times the current population with some change and improvements as discussed previously. There would have to be collection system improvements and expansion in order to serve a population increase of this magnitude. If the area were to experience growth beyond the present treatment plant capacity, it would probably be necessary to relocate the treatment facility and consider alternative effluent disposal methods.

McGILL

GENERAL

The community of McGill is unincorporated and governed by the White Pine County Commissioners. The community water and wastewater systems are owned and operated by Charles McKenzie as the Ruth McGill Water Company who purchased them from the John W. Galbreath and Company within the past year. Both the water supply and wastewater systems were constructed in the 1920's by Kennecott Copper Corporation and serve over 600 connections. Both systems are old and in need of repair to meet current demands.

WATER SUPPLY SYSTEM

1. Existing

Source

The source of supply for the community of McGill is the Kennecott Copper Corporation. Kennecott supplies McGill with water that is surplus to their mining and milling needs. The major source of water is flow from Duck Creek 10 miles from McGill which is diverted and transmitted to the Kennecott ore processing operations at McGill. The system also has a 600 gpm standby well used in times of shortage. Kennecott also has rights to springs near McGill which are for plant supply and for a community swimming pool.

The existing supply is sufficient for the current level of demand except in times of drought. The diversion rate from Duck Creek runs approximately 10 cfs where the in-plant need is 40 cfs. Kennecott extensively recirculates water in the plant and during the 1977 drought the well and spring were used extensively to make up Duck Creek supply shortages.

Transmission and Distribution

The town supply comes primarily from Kennecott's Duck Creek diversion. Water from Duck Creek is retained in two small reservoirs and diverted into the Kennecott transmission line. Water flows by gravity some 10 miles through the 37 inch line to Kennecott's plant. The McGill supply is tapped off at a rate of up to a maximum of 1000 gpm near the corporation's smelter.

Storage for the system is provided in a 150,000 gallon steel reservoir. Distribution is composed of 6 and 8 inch steel and AC feeder mains with 2 and 4 inch distribution mains. There has been replacement of some of the original system where severe problems have occurred. In general the distribution system is in poor condition. Fire protection is provided by both the domestic system and the Kennecott recycle water line from the tailing ponds.

The community of McGill does not hold any active water rights but depends upon Kennecott Copper Corporation for continued reliable supply.

Quality and Treatment

The quality of the McGill community supply meets State drinking water standards. A recent analysis is presented below.

McGill

Sample Date: 5/16/79

TDS	172 mg/l	HCO_3	183 mg/l
Hardness	177 mg/l as $CaCO_3$	CO_3	0
Ca	46 mg/l	F	0.12 mg/l
Mg	15 mg/l	As	0
Na	5 mg/l	Fe	0.01 mg/l
K	1 mg/l	Mn	0
SO_4	10 mg/l	Color	3
Cl	2 mg/l	Turbidity	0.2 JTU
NO_3	1.9 mg/l	pH	8.18
Alkalinity	150 mg/l	Se	--

The McGill town supply is chlorinated at two locations: 1) in the vicinity of the well, and 2) at the primary taps in the 37 inch transmission main from Duck Creek.

Financial

The unmetered McGill water system is financed through a flat rate set by the State Public Service Commission. No other source of revenue is available to the private company for upgrading the system.

2. Near Future System

There are no active plans to expand or make major improvements to the McGill water supply system at the present time. In 1972 a study was performed for the McGill Town Council which examined the feasibility of McGill water and wastewater facility rehabilitation. That study suggested the following:

Cost Estimates

Item	Description	Unit	Amount	Cost (dollars)
1	10-inch ACP transmission main including valves, fitting and appurtenances	lin. ft.	5,900	$ 60,475
2	6-inch ACP distribution main including valves, fittings and appurtenances (includes 13,500 lin. ft. of asphalt replacement)	lin. ft.	25,800	212,850
3	6-inch fire hydrants	each	68	40,800
4	6-inch regular station	each	2	7,000
5	Installation of service meters including meter pipe, fittings, valves, valve boxes, etc.	each	600	126,000
6	1.26 mg distribution storage tank, including site work, protective coating, etc.	L.S.	1	175,000
7	Gas chlorinator	each	2	7,000
	Total Estimated Construction and Engineering Costs, including contingencies			$777,000

These costs are approximately 10 years out of date and reflect only an upgrade of the system to meet the current level of demand.

3. Water Supply Expansion Capabilities

The existing water system has little if any expansion capability since it receives the majority of its supply from "surplus" water of Kennecott Copper Corporation. The Company needs virtually all of the existing supply for its current operation; therefore any substantial expansion of McGill would require a new or additional source of supply. These new supplies would most likely be groundwater from wells drilled in Steptoe Valley which is presently a designated groundwater basin.

WASTEWATER FACILITIES

1. General

The wastewater collection facilities are owned and operated by Charles McKenzie. The original sewers were installed approximately 60 years old.

Collection System

The existing collection system is composed primarily of 4 and 6 inch VC pipe not necessarily constructed in streets or alleys. A portion of the collection system at the lower elevations in town was constructed in 1968 using AC pipe. Most of the collection system is extremely shallow and subject to rupture. The entire collection system suffers from excessive clogging due to tree roots and is in need of total replacement.

Treatment

The present treatment for McGill effluent is in oxidation and settling ponds below town from which there is no active discharge. The ponds belong to and are maintained by Kennecott Copper Corporation.

2. Near Future Wastewater System

At the present time there are no active plans to expand or update McGill wastewater facilities. In 1972 the study for the McGill Town Council examined the then existing system and made recommendations for improvement in both collection and treatment. These included replacement of the collection system and the construction of an aerated lagoon system of treatment. The 1972 cost estimate for these facilities was $1,100,000

3. Future Expansion of Wastewater Facilities

The existing wastewater facilities are barely adequate for the existing town of McGill and the collection system is in need of replacement. Any substantial growth in the community would require the implementation of an entirely new wastewater collection and treatment system to serve the additional population. The 1972 cost estimates updated to the present would be in excess of $2,500,000.

RUTH

GENERAL

The community of Ruth is unincorporated and is governed by the White Pine County Commission. The community water supply and wastewater systems are owned and operated by Charles McKenzie under the name Ruth-McGill Water Company. The systems were acquired from the Gohn W. Galbreath Company during the past year. The water supply is obtained from Kennecott Copper Corporation. The systems presently serve approximately 600 persons.

WATER SUPPLY SYSTEM

1. Existing

Source

The source of supply for the town of Ruth is Ward Mountain Springs. The springs located approximately 18 miles south of Ruth flow between 70 and 400 gpm. The present Ruth requirement is approximately 200 gpm. The town water is purchased by contract from Kennecott Copper Corporation which developed the Ward Mountain Springs to facilitate the mining operations at the Ruth pit. The water supplied is only that which is surplus to Kennecott's other needs. The spring flow is generally adequate to serve existing demands except during times of drought. In 1977 when the spring flow was low the town purchased water from Ely through an agreement between the two entities. Even with supplemental water from Ely it was necessary to curtail lawn watering. The water rights which supply the town of Ruth are held by Kennecott Copper Corporation.

Quality and Treatment

The quality of the Ruth community supply meets State Drinking Water Standards. A recent analysis is presented below.

Sample Date 5/17/79

TDS	163 mg/l	HCO_3	193 mg/l
Hardness	187 mg/l as $CaCO_3$	CO_3	0 mg/l
Ca	55 mg/l	F	0.13 mg/l
Mg	12 mg/l	As	0 mg/l
Na	7 mg/l	Fe	0.02 mg/l
K	1 mg/l	Mn	0 mg/l
SO_4	15 mg/l	Color	3
Cl	4 mg/l	Turbidity	0.2 JTU
NO_3	2.1 mg/l	pH	8.16
Alkalinity	158 mg/l	Se	--

Source - Consumer Health Protection Service, Nevada Human Resources Department

The town supply is chlorinated.

Transmission and Distribution

Waters from Ward Mountain Springs are conveyed by gravity 13 miles through an 8 inch steel transmission to two 1 mg storage tanks. The water then moves the remaining .5 mile by gravity through a 6 inch main to a 0.3 mg reservoir above town. The above facilities are owned by Kennecott Copper Corporation.

Water from the terminal reservoir flows by gravity into essentially two systems. A 6 inch steel main supplies fire flows and maintains high pressures. The lower pressure domestic distribution is composed of 4 and 6 inch steel pipe. The domestic distribution system uncoated steel pipe is in poor condition and should be replaced.

The storage for Ruth is adequate except for extreme drought periods as recently experienced. The state has asked the Ruth-McGill Water Company to cover the two 1 mg storage tanks.

System Financing

The water system is financed by flat rate service charges for residential and commercial customers. The rates charged are set by the Nevada Public Service Commission (PSC). The current rates do not generate adequate revenue to comply with the state request to cover the storage reservoirs.

2. System Expansion

The existing Ruth supply has proven inadequate to meet even existing demands and therefore has no capacity for meeting increased demands. There are no active plans to expand the current system. Although the distribution system is in need of almost total replacement, system revenues do not provide adequate capital to undertake this endeavor. The company is considering asking the PSC for a rate increase to generate sufficient revenues to make improvements in both Ruth and McGill.

WASTEWATER FACILITIES

1. Existing System

Collection System

The Ruth wastewater collection system consists of some 6 miles of 6 inch or greater VC pipe collectors. The collection system originally installed between 1945 and 1950 is still in relatively good condition experiencing only minor maintenance problems.

Treatment Facilities

The Ruth wastewater collection system flows by gravity and discharges through a 12 inch outfall into a series of four ponds located approximately 1/2 mile northeast of town. The ponds are oxidation evaporation and percolation ponds with no mechanical aeration. The upper two ponds are fenced and the state has requested that the newer two ponds also be fenced. The upper ponds are filling with sludge but there is no active discharge from the pond system. The cost of fencing the lower ponds is estimated to be $10,000.

2. Wastewater System Expansion

There is no active plan to expand the current Ruth wastewater treatment or collection facilities. The existing facilities are adequate to serve the existing community. Any significant expansion would in all likelihood require an entirely new treatment facility to meet state standards.

BAKER, LUND, PRESTON

The communiteis of Baker, Lund and Preston are all unincorporated and governed by the White Pine County Commission. None of the communities has a community water supply or wastewater system.

WATER SUPPLY

The water supply for these three communiteis is provided by individual wells constructed as needed. The communities of Lund and Preston have relatively small static populations, approximately 30 and 60 persons. Neither of these has any active plans to construct a town supply. The community of Baker has experienced some growth in the recent past and there have been several proposed subdivisions. The people in the Baker area have considered developing a community supply but no action has been taken to date to secure a community supply and distribution system.

WASTEWATER

Each of the three communities uses individual underground disposal for wastewater. The percolation rates are high and this type of treatment is adequate under the current levels of population and lot size. The Preston and Lund areas have not experienced significant problems with individual disposal but the community of Baker has had some problems. The soils in the Baker area are so highly permeable that wastes from septic systems are contiminating individual shallow wells. The county recently denied one proposed subdivision due to possible ground and surface water contamination from septic tanks. At the present time growth is limited in the Baker area until a community supply is developed.

SOURCES OF INFORMATION

EUREKA

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2. Eureka County General Plan, June 1974, Thomas A. Conger, Sharp, Krater Engstrom & Associates, Inc., Reno, NV, Volumes I and II.

3. Mr. Richard Forman - Boundy and Forman Engineering, Ely, NV.

4. Mr. Mike Latin - Chilton Engineering, Elko, NV.

5. Mr. Harry Van Drielen and Ms. Debbie Vineyard, Department of Environmental Protection, Nevada Department of Conservation and Natural Resources, Carson City, NV.

6. Ms. Karen Frazier - Consumer Health Protection Services, Health Division, Nevada Department of Human Resources, Carson City, NV.

7. Mr. Charles Knaus - Insurance Division, Nevada Department of Commerce, Carson City, NV.

8. Water Right Abstracts - Office of the State Engineer, Division of Water Resources, Department of Conservation and Natural Resources, Carson City, NV.

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2. Mr. Jerry Allen - Chairman, Esmeralda County Commission, Goldfield, NV.

3. Ms. Jacqueline Mitchell - Facilitators, Inc., Las Vegas, NV.

4. Mr. David Hamilton - Nye County Planning Director, Tonopah, NV.

5. Mr. Harry Van Drielen and Ms. Debbie Vineyard, Department of Environmental Protection, Nevada Department of Conservation and Natural Resources, Carson City, NV.

6. Ms. Karen Frazier - Consumer Health Protection Services, Health Division, Nevada Department of Human Resources, Carson City, NV.

7. Mr. Charles Knaus - Insurance Division, Nevada Department of Commerce, Carson City, NV.

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2. Mr. Mike Latin - Lander County Engineer, Chilton Engineering, Elko, NV.

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2. Mrs. Ann Morrisy, Chairperson, Town Board, Alamo, NV.

3. Mr. Jim Morrisy, Alamo Sewer and Water General Improvement District Board, Alamo, NV.

4. Mr. Mike Fogliani, Chairman, Three County MX Oversight Committee, Pioche, NV.

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6. Mr. Roy Hibdon, Rob Hibdon Civil Engineering Consultant, Reno, NV.

7. Mr. Harvey Brotzman, Roy Hibdon Civil Engineering Consultant, Reno, NV.

8. Ms. Karen Frazier - Consumer Health Protection Services, Health Division, Nevada Department of Human Resources, Carson City, NV.

9. Mr. Charles Knaus - Insurance Division, Nevada Department of Commerce, Carson City, NV.

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3. Mr. Gary McBride - member, Panaca Town Board, Panaca, NV.

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5. Mr. Harry Van Drielen and Ms. Debbie Vineyard, Department of Environmental Protection, Nevada Department of Conservation and Natural Resources, Carson City, NV.

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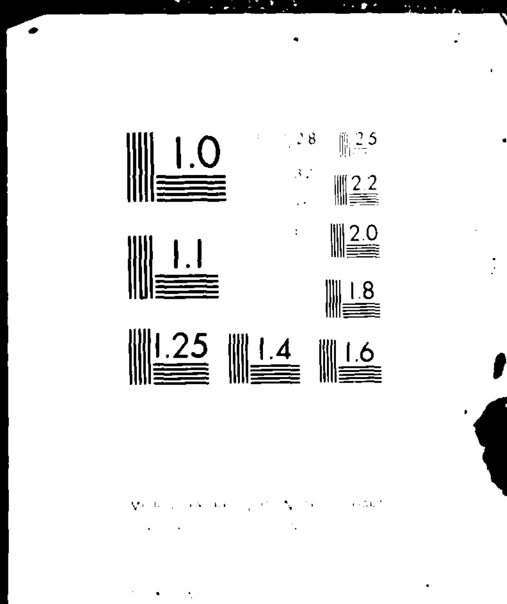

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8. Ely Water Board - Meeting of 2/28/80.

9. Mr. Neil Jensen - White Pine County Clerk, Ely, NV.

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4. Mr. Roy Hibdon - Roy Hibdon Civil Engineering Consultant, Reno, NV.

5. Mr. Ralph Orgil, Mr. Jim Rassmussen, Mr. Van Peterson, Mr. Roy White - Engineering and Management, Kennecott Copper Corporation, McGill, NV.

6. Mr. Neil Jensen - White Pine County Clerk, Ely, NV.

7. Mr. Harry Van Drielen and Ms. Debbie Vineyard, Department of Environmental Protection, Nevada Department of Conservation and Natural Resources, Carson City, NV.

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2. Mr. Ronald Pekuri - Manager, Ruth-McGill Water Company, McGill, NV.

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APPENDIX B

Municipal Water Resources Analysis for Area
Potentially Impacted by MX Missile Complex
in Utah

MUNICIPAL WATER RESOURCES ANALYSIS FOR AREA POTENTIALLY IMPACTED BY MX MISSILE COMPLEX IN UTAH

by

Trevor C. Hughes, V. A. Narasimhan,
William J. Grenney and
L. Douglas James

Project Completion Report
Submitted to
Fugro National, Inc.

USU Foundation
Logan, Utah

April 1980

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SCOPE OF REPORT

This report analyzes the impact of the proposed MX Missile complex upon existing municipal water supply and waste treatment systems serving selected communities either near the perimeter or within the Utah portion of the proposed MX complex boundary. As can be seen from the location map in Figure 1, possible sites for elements within the total MX missile complex have been identified in 14 Utah desert valleys in the five counties, from north to south, of Tooele, Juab, Millard, Beaver, and Iron.

The 60,000 people, who live in these counties according to the 1975 census, are largely located in their eastern ends of the base of a series of mountain ranges with numerous peaks over 10,000 feet. Sites closer to these mountains have a more dependable and higher quality water supply from the snowpack runoff. Surface runoff evaporates or infiltrates underground and waters generally become more saline as one moves further west into the desert. The desert ranges, separating the 14 valleys, are lower, generate much less runoff, and streams flow only for short periods, during spring snowmelt or summer thunderstorms, to recharge aquifers along the basin margins.

Interstate 15, the main highway from Salt Lake to Las Vegas, passes through the towns of Nephi, Fillmore, Beaver, Parowan, and Cedar City and the best farming country in the region along the base of the mountain ranges at the eastern edge of these counties. About 20 miles further west, the Union Pacific Railroad corridor passes through the towns of Delta and Milford and several small villages of population less than 50 as it roughly demarcates the farming country to the east from the desert

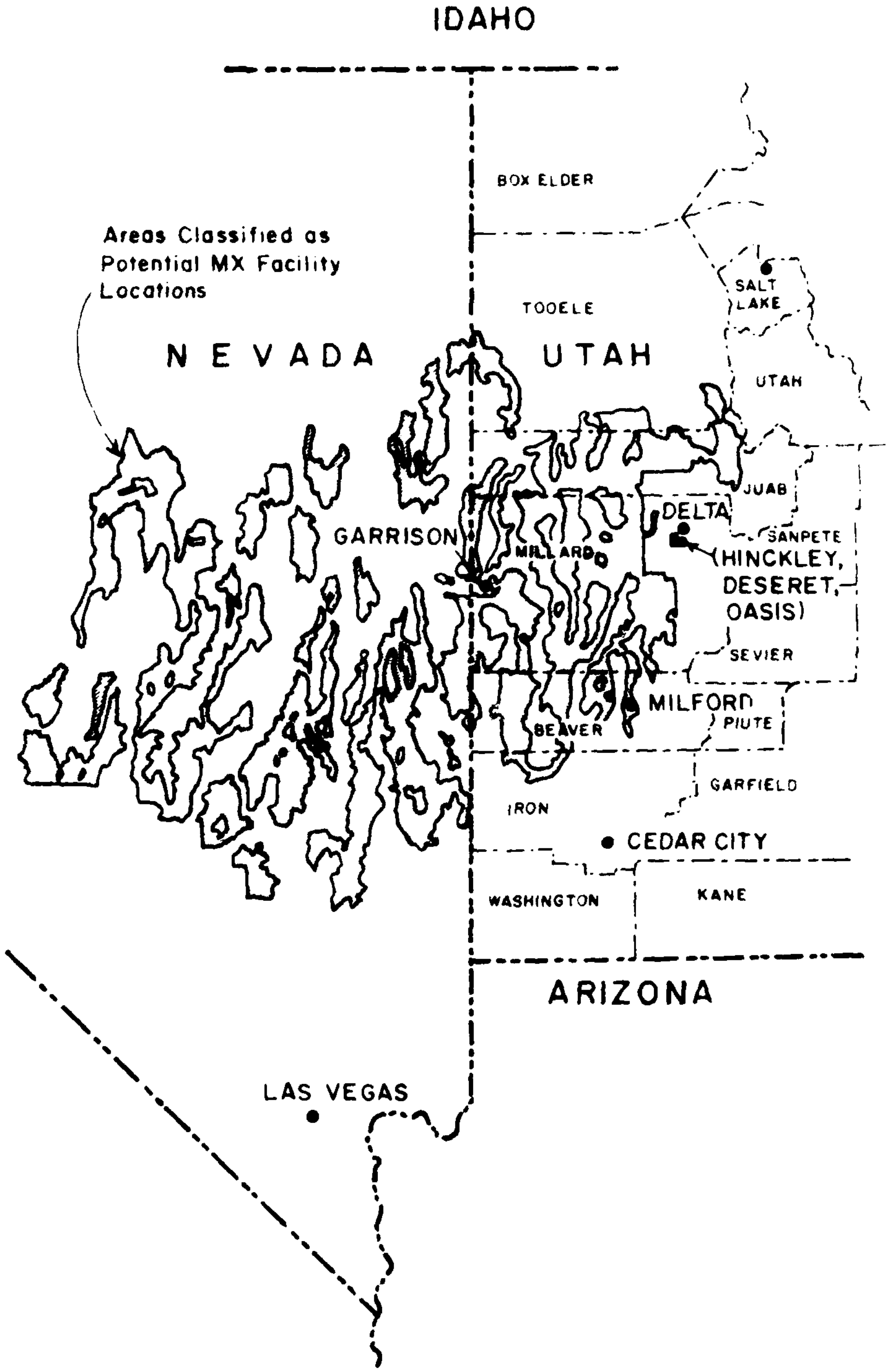


Figure 1. MX impact area location map.

valleys being considered as MX missile sites further west. The 100-mile wide strip between the Union Pacific Corridor and the Nevada border is extremely sparsely inhabited with the largest single community being the 60 people who live at Garrison.

Generally, nature provides more water on the basin margins along the eastern sides of these five counties. However, because the water is more readily available and easier to develop there, almost all available supplies are fully appropriated and new users can only obtain water by purchasing prior rights. Further west, surface water (and therefore early development) has been very limited, and significant amounts of groundwater remain unappropriated. Much would have to be pumped from deeper aquifers.

The specific communities assigned for analysis of their water supply and wastewater treatment systems in this study are Delta, Milford and Cedar City plus an overview of impact upon the water supply situation in the smaller communities of Hinckley, Deseret, Oasis (all a few miles southwest of Delta) and Garrison, near the Utah-Nevada border. The locations of these cities and villages in relation to the potential MX storage sites are shown in Figure 1.

The report begins by presenting the pertinent hydrologic information, particularly groundwater hydrology, for areas immediately adjacent to the communities of interest. The hydrology of the other valleys where the MX sites are contemplated is not within the scope of this report.

The second major section of the report is a description of the existing municipal water systems for these seven communities, their current water requirements, their capacity without any expansion, and, finally, an assessment of the expansion in water rights and various components of each system which would be required to serve an assumed MX related growth scenario in each region.

The final section is a similar analysis of existing wastewater collection and treatment facilities and of how they would be affected by the growth scenarios. In addition to possible MX related growth, the Delta area is also facing probable construction of a very large coal-fired power generating complex known as the Intermountain Power Project (IPP). The water and wastewater demand projections are based upon assumed normal growth "without MX" (including the proposed Intermountain Power Project (IPP) impact in the Delta area) plus MX related growth. The MX-related population growth projected for Utah amounts to a population increase of 30,000 (employees, dependents and indirect) by 1987 at the peak of MX construction. The population increase was assumed to be distributed by community as follows:

Area	MX Peak Population
Delta	12,500 (10,250 in Delta and 2250 in Hinckley/Deseret/Oasis)
Milford	12,500
Cedar City	5,000

About slightly over half of this MX-induced population would be expected to remain after 1995 when construction is completed.

Since MX base siting information is not yet available. These estimates are simply one possible scenario. For convenience in using the results of this study with various projections, the impact of population growth upon water resources in each area is tabulated in per person or per connection as well as total volume dimensions so that the water impacts associated with various projections can easily be calculated.

HYDROLOGIC SYSTEMS

Since the available surface water supplies in all locations within the areas of interest are completely allocated for other beneficial uses and since groundwater is much more desirable for municipal use due to minimal treatment required, the hydrologic analysis will be limited to groundwater resources in the vicinity of the seven communities of interest.

I. Milford City

1. Occurrence and Movement of Groundwater.

The unconsolidated materials underlying the Milford area contain the principal groundwater reservoir. This groundwater reservoir consists of three zones of high permeability separated by zones of low permeability. the thickness of this reservoir varies throughout the valley, reaches a maximum of about 840 feet about 21 miles south of Milford. Groundwater moves from deeper to shallower zones within the groundwater reservoir throughout most of the valley because the hydrostatic pressure in the deeper zones causes upward leakage through the confining beds into shallower zones. The general direction of water movement in the principal groundwater reservoir as indicated by water level contours is to the north.

2. Groundwater Budget.

Based on the groundwater budget estimated by Mower and Cordova (1974) an appraisal of the recharge to and discharge from the principal Milford Valley groundwater reservoir for the year 1970-71 is shown in Table 1. This year was close to average in terms of moisture availability. The estimates indicate that the consumptive use of phreatophytes (in the

Table 1. Milford Valley groundwater budget, 1970-71 (Mower and Cordova, 1974).

Hydrologic Parameter	Source	Quantity
1. Recharge	Subsurface inflow:	1,700 acre feet
	Tributary Valleys	
	Big Wash	2,200 acre feet
	Bed Rock	16,000 acre feet
	Seepage: Streams	5,000 acre feet
	Canals	8,500 acre feet
	Deep percolation from farm land	22,700 acre feet
	Infiltration from precipitation	2,100 acre feet
	Total	58,200 acre feet
2. Discharge	Irrigation	56,000 acre feet
	Public supply and industrial	800 acre feet
	Domestic and stock	100 acre feet
	Evapotranspiration from ground-water	24,000 acre feet
	Thermo hot springs	100 acre feet
	Subsurface and flow to black rock desert	Negligible
	Total	81,000 acre feet
3. Storage	Entire groundwater reservoir	40 Million ac ft
4. Releases from storage	Per 1 foot of water level decline (March 1972 altitude)	84,000 acre feet
	Per 1 foot of water level decline (100 feet lower than March 1972 altitude)	52,000 acre feet

nonirrigated low lying lands) accounts for 30 percent of the annual discharge from the groundwater basin. Irrigation is the major use of groundwater--70 percent of total discharge and 98 percent of beneficial use. Municipal and industrial users divert less than 2 percent of annual beneficial use.

3. Trend in Water Levels and Groundwater Storage.

The time series of plotted depths to groundwater through the spring of 1979 (Figure 2) indicate that the increased pumping of groundwater, especially since about 1950, combined with low normal precipitation during the 1960's, has dropped the water level as much as 30 feet (1 foot per year average) and reduced aquifer storage by about 410,000 acre-feet. This decline in water levels has caused compaction and land subsidence in the areas of heavy pumping south of Milford. As the water table drops, each additional foot of decline occurs with less water mined. As a result of this mining of groundwater the State Water Rights Engineer has closed the basin to further water appropriation.

4. Interference Among Wells.

Even though new appropriations are not granted, a municipality can purchase water previously pumped by an irrigator and drill a new well at a more convenient location. Before permitting this, the State Engineer must be convinced that the shift will not cause undue interference with older wells near the new municipal well site. Mower and Cordova (1974) reported the results of a hypothetical study indicating that significant interference among wells could occur in the Milford Valley. As an example, pumping a 1000-gpm well for 180 days could cause drawdown at a

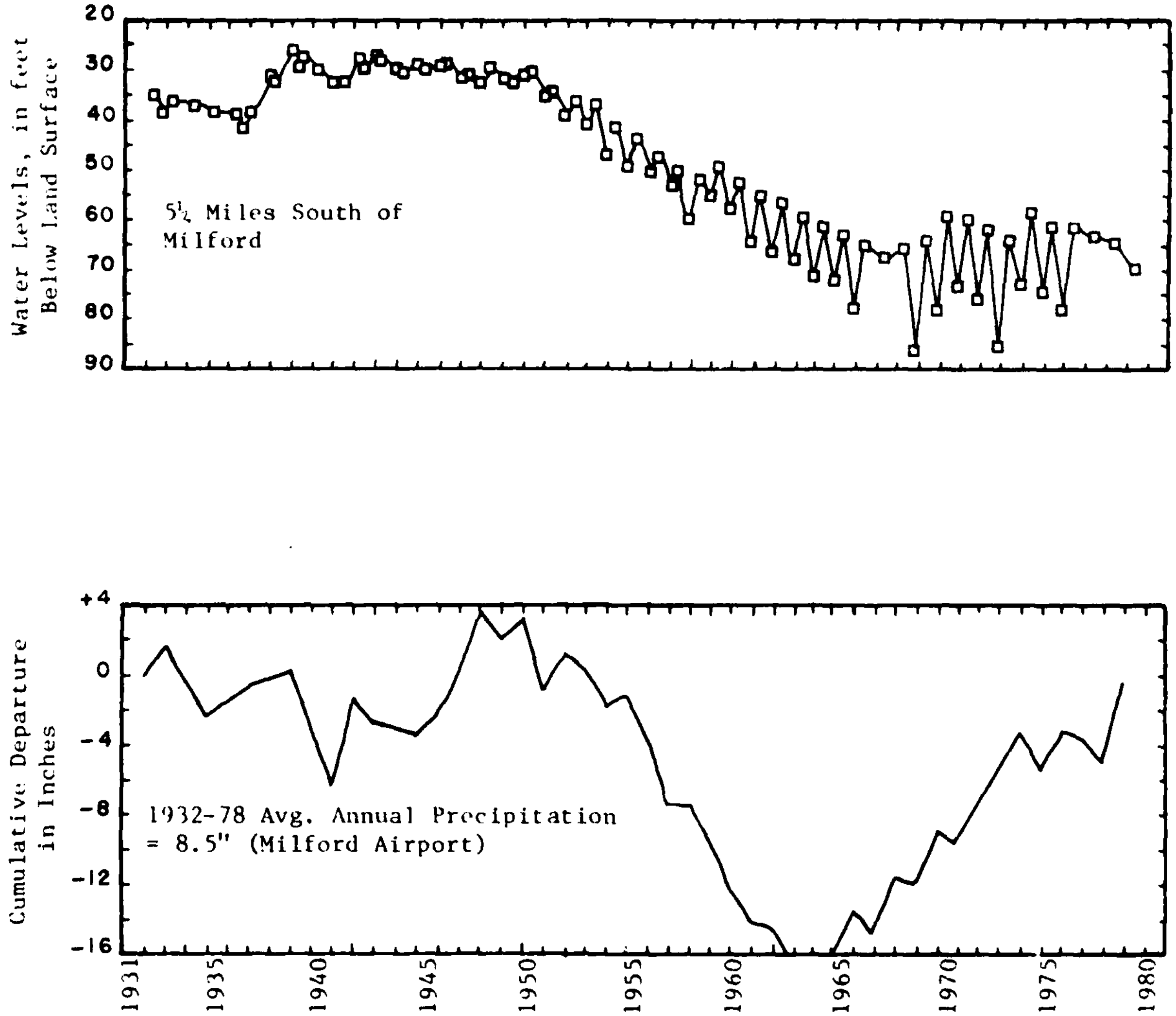


Figure 2. Relation of water levels in Milford area to cumulative departure from average annual precipitation.

well 1 mile away of 2.5 to 7.5 feet for a corresponding range of transmissivity value of 10,000 - 40,000 ft^2/day (storage coefficient assumed at 0.001).

5. Effect of Pumping Layered Aquifers.

The current usual upward hydraulic gradient from the deeper to shallower water bearing zones in this valley may be reversed locally by pumping, causing the hydraulic head in deeper zones to decline below the head in shallower zones. During such periods, poor quality water (from canal seepage and deep percolation from irrigated fields) moving through the shallower zones may mix into groundwater in the deep zones. Progressive water quality deterioration results.

6. Water Quality.

The culinary wells in Milford City have low dissolved solids content (about 230 mg/l). However, because of salinity moving in from shallow aquifers associated with groundwater mining in recent years, the chemical quality has been deteriorating in the Milford Valley. Data reported by Mower and Cordova (1974) indicate that the median dissolved solids (TDS) content of the well water supplies in the entire valley is 570 mg/l. The wells pumping from a shallow aquifer in the vicinity of Milford had much higher TDS content, for example -(1) 3360 mg/l in a well located north of Milford; and (2) some irrigation wells south of town contained 2310 to 2950 mg/l. Such water is from an aquifer much more shallow than that which the City wells use; however, mixing between the aquifers if groundwater mining is increased is a possibility.

7. Prospects for Further Groundwater Development.

Because of the dropping water table caused by pumping at a rate faster than the recharge and associated salinity increases, the Utah Division of Water Rights has closed the groundwater basin to new water development. If Milford's municipal supply is to be increased by purchasing existing irrigation rights, careful attention should be given to well location and capacity so as to minimize both interference among wells, and water quality deterioration due to excessive local drawdown. New wells need to be located where they will not reduce the head in the deeper aquifers to the point of reversing the hydraulic gradient and causing entry of water from the more saline shallow aquifers.

II. <u>Delta City</u>

1. Occurrence and Movement of Groundwater.

Interbedded basin fill deposits (coarse unconsolidated sediment) form the groundwater reservoir beneath Delta City. The aquifer system exceeds 1000 feet in thickness and is composed of the lower artesian, the upper artesian, and the shallow water table zones. The beds of the coarser material in each artesian aquifers are connected laterally, but locally they are separated vertically by fine-grained beds, resulting in impeding the vertical movement of water. The general direction of water movement in the upper artesian and unconfined aquifers (as indicated by water level contours) is toward Sevier Lake (Mower and Feltis, 1968) to the southwest.

2. Groundwater Budget.

No groundwater budget analysis s[illegible]es that reported for Milford is available for Delta. The best that could be developed is the semi-quantitative assessment made for this study and reported in Table 2. The indication is that 1) seepage from streams and canals are probably the

Table 2. Delta area groundwater budget (after Mower and Feltis, 1968).

Hydrologic Parameter	Source	Quantity Acre-Feet
1. Recharge	Infiltration from precipitation	5,000 - 12,000
	Seepage from streams and canals	Major recharge
	Irrigated fields	25% of water diverted
	Inflow from unconsolidated rocks	Not estimated
	Underflow from other basins from	
	Pavant Valley	14,000
	Beaver River	1,000
2. Discharge	Subsurface outflow	<5,000
	Flowing wells	<1,500
	Pumped wells	29,000
	ET from phreatophytes	135,000 - 175,000
	Evaporation from Severe lake playa	2,000
3. Storage	(2000 sq mi x 775 feet thick x .40 water content)	1 billion
4. Water release from storage	For 20 ft reduction in piezometric head	120,000

major sources of recharge and 2) although the total storage in the ground-water aquifer is about 1 billion acre feet, the estimated water release from the storage would be only 120,000 acre feet for a 20 foot reduction in the piezometric head.

3. Trend in Water Levels.

While water level data are not available for Delta City, the water levels have declined over the years since the wells were originally constructed, as evidenced by the need to increase the stem lengths for the pumps to be able to pump water at all times. The highest annual water level is usually in March, after which levels drop with heavy irrigation withdrawals during the irrigation season. The long term trend in water levels in two wells near Delta City (Figure 3) indicate a long-term trend of declining artesian head. However, during the period March 1978 - March 1979, the observed rise in the upper artesian aquifer was 2.6 feet in an observation well located about 2 miles southeast of Delta (Don Price, 1979). The increase was probably due to the above normal precipitation in the area resulting in reduced groundwater withdrawals for irrigation.

4. Interference Among Wells.

Although no study was done at Delta City, the studies of Mower and Feltis (1968) in the Lynndyl area (about 8 miles to the northeast) indicate that significant interference could also occur in the vicinity of Delta City. For a 1000-gpm pumping for 180 days, the water level decline could be about 7 feet in a well located at a distance of 2 miles, assuming a transmissivity of 50,000 gpd/foot and a storage coefficient of 0.001 Since the groundwater is extensively used in this valley, it will be necessary to consider the interference aspects in locating new wells for additional water supplies.

5. Effect of Pumping the Upper and Lower Artesian Aquifers.

The lower artesian aquifer is tapped by the municipal wells in Delta, while elsewhere in the valley the upper artesian aquifer is tapped by most of the domestic and stock wells. Data are not available to estimate the effects of simultaneous pumping of both the upper and lower aquifers in the vicinity of Delta. If appreciable leakage exists through the aquitard separating the upper and lower artesian aquifers, water quality deterioration could be expected to result from the simultaneous pumping from both the aquifers.

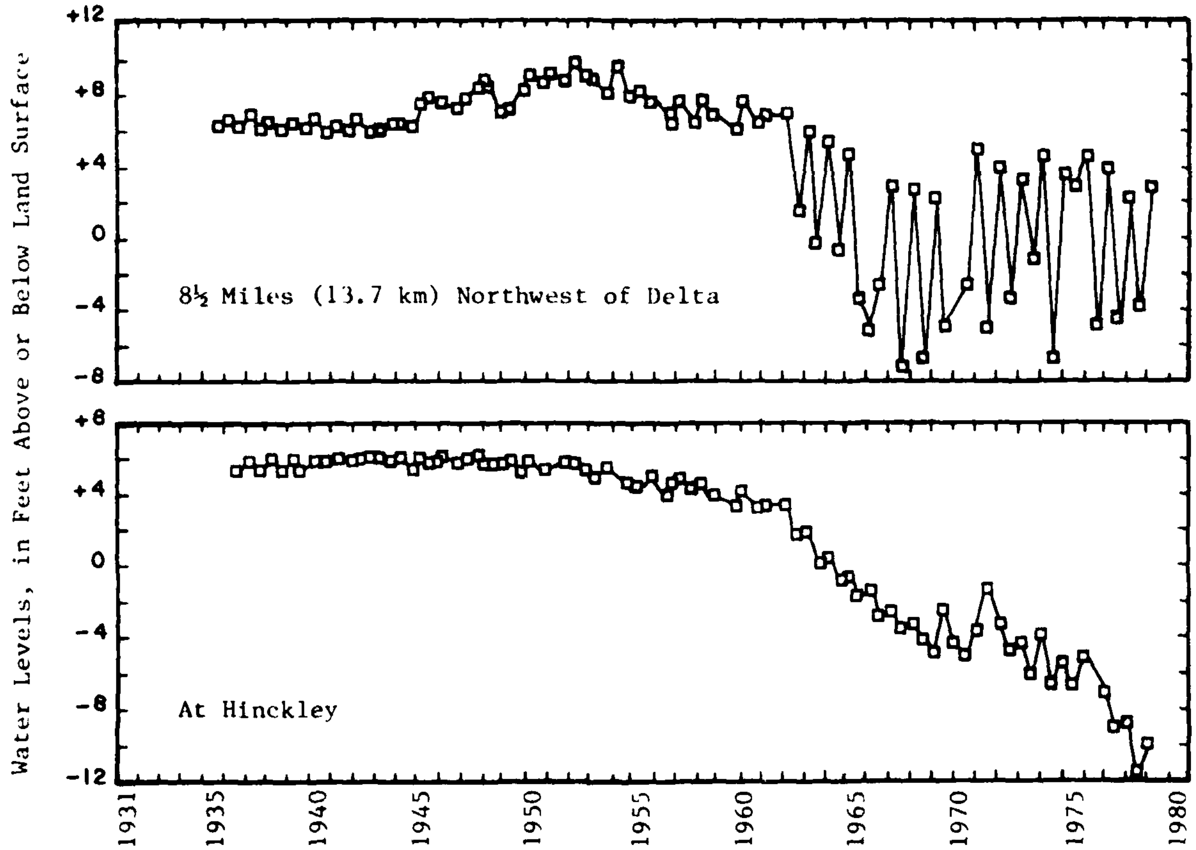


Figure 3. Long term trend in water levels in selected wells near Delta City and Hinckley.

6. Water Quality.

Presently, the Delta City culinary supply is of excellent quality as the City is located where it can take advantage of the fresh water supply recharged from the Sevier River into the upper and lower artesian aquifers. The TDS concentration in the vicinity of the town is 250 - 500 mg/l. Concentrations of over 2000 mg/l may be found to the southwest and also upstream from Delta due to highly saline water from irrigation recharge. The fresh water is percolating slowly toward the southwest, and it is being followed by saline water. Under the present hydraulic gradients, and present level of development in this area, water containing 1,000 ppm of dissolved solids are forecast to reach the Delta area in 100 - 150 years (Mower and Feltis, 1968).

Although Delta City does not treat its present culinary water supply, careful observation of the arsenic and fluoride levels in the culinary supply is recommended as a precautionary measure. Groundwater to the south contains very high levels of arsenic (see Hinckley water system discussion).

7. Prospects of Further Groundwater Development.

The Utah State Division of Water Rights will not allow additional groundwater (or surface water) development in this basin. As in the case of Milford, additional municipal supply will have to be developed via change in use of some existing irrigation right.

Of the 29,000 acre feet currently being pumped from the aquifers (Table 2) only 555 acre feet (2 percent) is being used for municipal purposes. A major increase in this amount (and corresponding decrease in irrigation) should be possible with little hydrologic impact _if_ the new wells are properly sized and located, considering local interference and water quality. In this regard, it is important to note that although Delta's municipal wells produce excellent quality water, only 4 miles to the south and west groundwater is unsuitable because of arsenic levels and only a few miles north, groundwater contains unacceptable levels of salinity, therefore a major new municipal well field represents a difficult balance between interference and quality. It may be necessary to accept significant interference in order to obtain adequate culinary quality.

III. Cedar City

1. Occurrence and Movement of Groundwater.

Productive groundwater aquifers in the vicinity of Cedar City are limited to the springs located in the upland or bed rock areas in the mountain slopes and to the unconsolidated valley fills. Three particular areas where groundwater is relatively available are the Coal Creek alluvial fan, an area west of Quichapa Lake, and the Quichapa Lake playa area. Groundwater in the unconsolidated valley fill occurs under leaky artesian conditions. But along the mountain front at, and north of, Cedar City, it exists under unconfined conditions. The general direction of movement of groundwater is toward the valley floors. Locally the direction of movement could be altered or reversed by pumping.

2. Groundwater Budget.

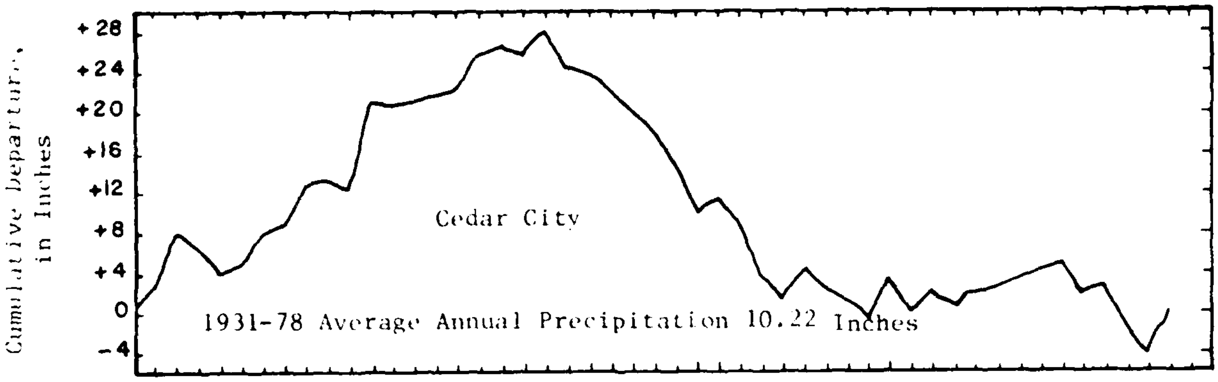
Most of the precipitation is consumed by evaporation and transpiration by vegetation in the basin, and only a small percentage percolates to the groundwater reservoirs. Based on the hydrologic estimates of Bjorklund et al. (1978), an appraisal of the recharge to and discharge from the principal groundwater reservoirs for 1974 is shown in Table 3. The annual water balance suggests a net annual decrease in groundwater storage of approximately 4400 acre feet and a general decline in the water levels.

3. Trend in Water Levels.

The time trend in depth to groundwater to the spring of 1979 (Figure 4) shows a general decline in water level. Seasonal fluctuations in the

Table 3. Cedar City vicinity groundwater budget 1974 (Bjorklund et al., 1978).

Hydrologic Parameter	Source		Quantity
1. Recharge	- Directly from precipitation		40,000 acre feet
	- Springs from bed rock and mountain slopes		Unknown
	- Seepage from stream diviersions (6,000 - 12,000 acre feet)		Unknown
	- Subsurface inflow		Unknown
2. Discharge	Seeps	< 500	
	Evapotranspiration		
	Surrounding Quichapa Lake	1,600	
	Quichapa Lake	500	
	Wells	42,300	
	Total (excluding e.t. from phreatophytes)		44,900
3. Storage	Unconsolidated valley fills		20 Million
	Consolidated rocks in the mountains		Not estimated
4. Release from storage			A small percentage is economically feasible



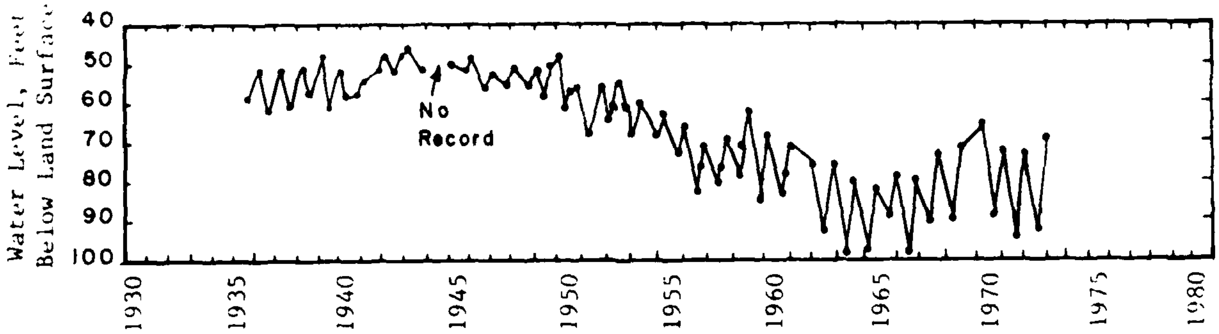


Figure 4. Relation of water levels in selected wells in the Cedar City area to cumulative departure from average annual precipitation.

water level also occur with spring recharge and summer pumping. During the wet period March 1978 - March 1979, however, significant rises in water levels occurred in the vicinity of Cedar City.

4. Interference Among Wells.

In artesian areas, such as most of the Cedar City Valley, drawdown by interference and recovery when pumping stops are both relatively rapid and affect large areas because the interference is caused mostly by a reduction in hydrostatic pressure in the confined aquifer. Measurements in the general area presently supplying water to Cedar City were reported by Bjorklund et al. (1978) as shown in Table 4. Because of the large number of wells already pumping in the Cedar City Valley and these artesian conditions, it is especially important to consider interference aspects in locating new wells for additional water supplies near City City.

Table 4. Interference drawdown in wells near Quichapa Lake, Cedar City Valley.

Pumping Quantity gpm	Distance of Observation Well (feet)	Interference Drawdown (ft)	
		Drawdown (feet)	Time
1345	652	0	3 minutes
		2.76	30 hours
845	1000	0	2 minutes
		15.16	46.1 hours
	2650	0	3 hours
		5.5	86 hours

5. Water Quality.

Presently, water of relatively low dissolved solids (less than 400 ppm) occurs in the Cedar City Valley. The water is generally classified as a calcium or magnesium sulphate type due to the gypsum bearing rocks which are exposed in the basin. Since the groundwater basin is essentially a closed basin and since the groundwater is extensively used in the valley for irrigation, long term deterioration in water quality is expected over the years. The data, however, are insufficient for quantitative projection.

6. Prospects of Groundwater Development.

The groundwater resource in the unconsolidated alluvial aquifers in the Cedar City Valley should be regarded as fully developed and closed to large new wells (Bjorklund et al., 1978). The State Division of Water Rights agrees with this assessment and has closed the basin to further water development. In seeking sources for additional culinary supplies, consideration may be given to 1) purchasing irrigation water rights, and 2) developing new groundwater resources in deeper bed rock aquifers (Navajo sand stone) in the mountains east of the City. The City recently drilled a test well into the Navajo sand stone but was unsuccessful in locating a significant quantity of water.

IV. Hinckley, Deseret, and Oasis

The three communities, Hinckley, Deseret, and Oasis, located about 8 miles southwest of Delta, are underlain by the same aquifer as Delta but far enough downstream for the water to be much more saline. The groundwater beneath these communities is comprised of three zones; a shallow perched aquifer and two artesian aquifers (upper and lower). The culinary, industrial, and irrigation water supplies are withdrawn from the lower artesian aquifers.

The groundwater recharge to the aquifer in the vicinity of these communities is primarily from the seepage from rivers, streams, and canals on the perimeters of the basin. More upstream sources of recharge are the same as listed in Table 2 for Delta City. The direction of groundwater movement, as indicated by the water level contours, is from northeast to southwest.

The artesian water in this aquifer is relatively saline (TDS of 500-1000 mg/l) as compared in the aquifer under Delta. The major water quality problem in Hinckley is arsenic, which exceeds EPA's maximum contaminant level (50 micrograms per liter, μg/l) by three times. The arsenic concentrations range from 10 μg/l near Delta to 500 μg/l several miles southwest of Oasis (Kaiserman Associates, 1979). Increasing arsenic concentrations occur in the direction of groundwater movement and with decreasing upper artesian aquifer water levels, indicating that increasing amounts of arsenic are dissolved as the water passes through or over strata containing arsenic bearing compounds. Fluoride is also a possible problem.

V. <u>Garrison</u>

The tiny village of Garrison is in Snake Valley. This large valley near the Nevada border has the largest amount of fresh groundwater in relatively permeable material (about 12 million acre feet in the upper 100 saturated feet) of any valley in the western Utah desert area (Gates, 1980). Water budget information is not available but results of a reconnaissance study suggests that major growth in this valley would have less hydrologic impact than that in any of the other more developed areas included in this report.

MUNICIPAL WATER SYSTEMS

I. Milford City

1. Water Source.

All of Milford's municipal water is pumped from deep wells. The City owns five wells, three of which deliver water to the domestic water system. One other could be used for the domestic system but is currently used only for irrigation of the fair grounds; and from one shallow well only irrigation of the cemetery (March 15 to October 31) is permitted. The existing water rights as well as pump capacities are shown in Table 5. Well and reservoir locations are shown in Figure 5.

2. Current Water Usage.

Milford has historically had one of the highest per capita water use rates in the State of Utah. Two contributing factors are 1) Milford is one of the few Utah cities without *metered service* connections (a flat rate produces no incentive to conserve) and 2) a high rate of leakage. An

Table 5. Milford City well capacities (Kaiserman, 1978).

Well	Max. Dia.	Depth	Water Right (gpm)	Pump Capacity	Use Permitted
1. City Shed	16"	467'	500	420	Domestic
2. Library Park	18"	468'	450	420	Domestic
3. Jakes Well	14"	504'	763	420	Domestic
4. Ball Park	12"	180'	265	265	Domestic or Irrigation
5. Cemetery	7"	102'	262	262	Irrigation Only
		Total Water Right	2240 gpm		
		Total Culinary Right	1978 gpm		

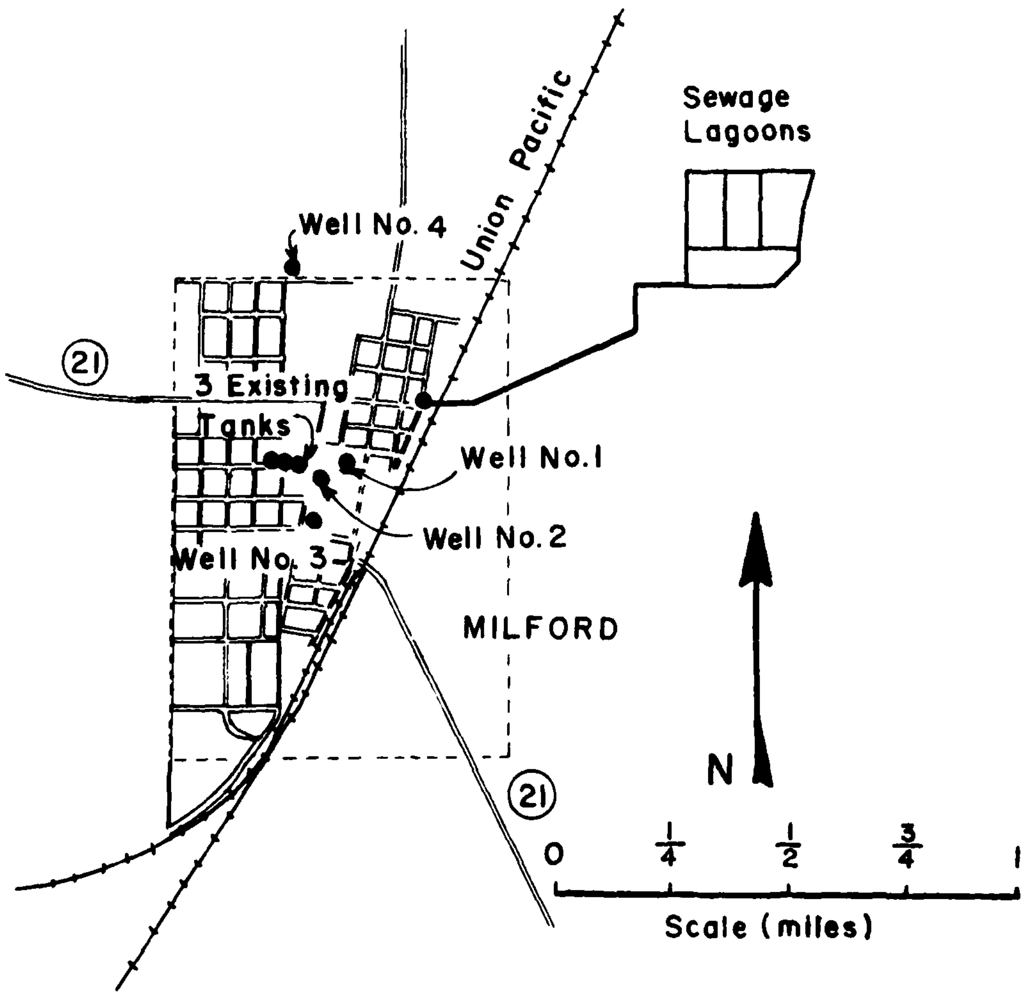


Figure 5. Milford water and sewer system principal facilities location map.

unusually large amount of leakage is caused by a) a corrosive soil which causes rapid deterioration of metal pipe; b) some original pipes still have lead joints, most of which leak, and c) many homes have leaking faucets and toilets. The last situation is directly related to the lack of meters (no economic incentive to repair leaks).

The average and peak month water consumption rates are now approximately 400 and 800 gallons per capita per day (gpcd) respectively. Actual rates have fluctuated from year to year depending upon the extent of leakage control efforts by the city. Use rates are calculated from total volumes of domestic use in Table 6 (not including municipal irrigation uses such as cemetery and fairgrounds but including *residential* irrigation).

The Kaiserman report does not include historic peak day water use data. This, however, can be estimated from the generalized Utah municipal demand functions developed by Hughes and Gross (1979). Their function relating average to peak day is $D_{pd} = 2.5\ D_{avg} - 50$ where demands are

Table 6. Milford City water consumption (Kaiserman, 1978).

Year	Population	Total (Gal)	Peak Month (Gal)	GPCD Ave.	GPCD Peak
1969	1300	183,865,000	36,626,100	387	939
1970	1304	189,152,200	29,567,800	397	756
1971	1337	196,358,300	32,318,400	402	806
1972	1369	223,825,000	35,605,600	448	867
1973	1402	192,489,800	34,630,000	376	823
1974	1434	221,645,000	34,380,100	423	799
1975	1467	196,878,100	26,789,800	368	609
1976	1500	222,980,800	30,468,700	407	677
Typical	1500	219,000,000	36,000,000	400	800

in gallons per capita per day (gpcd). For the Milford annual average of 400 gpcd, this function gives 950 gpcd. However, the equation was developed with data from metered systems (where constant leakage losses are less), and the resulting estimate is probably too high for Milford. This bias is illustrated by their similar function for peak month of $D_{pm} = 2.43\ D_{avg} - 108$. This equation implies a peak month use of 864 gpcd which is 8 percent higher than the Milford measured quantity of 800. The same 8 percent reduction in the 950 gpcd estimates for the peak day suggests 874 gpcd as the expected value of peak day demand.

3. Maximum Capacity without Changing System.

a. Source and treatment facilities: The groundwater is generally of good quality and the City has no treatment facilities whatever. In recent years, however, several samples with unacceptable colliform counts have resulted in the State Division of Health recommending the addition of a chlorinator to the system. No additional future treatment is anticipated.

Milford's water rights total 1978 gpm which amounts to 85 mg per month compared to the 36 mg estimated for the typical year in Table 2. Obviously the existing water right is more than adequate for future non-MX growth.

The actual production capability of existing pumps (three culinary pumps only since irrigation demand requires the total capacity of the other two pumps during peak summer periods) is 1260 gpm. These pumps will therefore produce only about 54.4 mg during peak months--49 mg if 10 percent down time is allowed for maintenance. This amounts to a 36 percent excess capacity average during a current peak month. However, during peak days (which is the correct time increment for determining pump capacity on a system with adequate equalizing reservoir capacity) the 874 gpcd demand and 10 percent down time for pumps indicates that the 1134 gpm current daily production capacity has 30 percent excess capacity. In other words, a 30 percent growth to a population of 1950 would increase water use to equal existing pumping capacity.

b. Storage: Milford's water storage system consists of three steel tanks as follows:

Reservoir	Capacity (Gal)	Construction Date
1	85,000	1920
2	100,000	1937
3	125,000	1910
Total	310,000	

The reservoirs are all quite old and experience some leakage. The City is currently attempting to finance construction of an additional reservoir. The new Utah Division of Health standard requires 400 gallons of storage per connection for indoor residential use. Since all residential irrigation in Milford is provided from the municipal system, an additional increment of residential storage (assumed to be equal to the indoor requirement) is also required. The total storage requirement for the 460 existing connections at the 800 gallons per connection figure is 368,000 gallons. Finally, consideration must be given to the availability of water for fire fighting. Kaiserman Associates estimate the Milford requirements for fighting a 5-hour fire at 367,500 gallons or 1225 gpm. Since the existing pumps can more than deliver this amount of water and the above storage required could also more than supply it should that be necessary, adequate storage for the present Milford population will be estimated as 368,000 gallons or 16 percent more than is now available.

c. Distribution System: The existing distribution system pipe lengths by size are summarized as follows

Diameter	Length (ft)
4"	8,000
6"	18,800
8"	10,400
12"	2,200
Fire Hydrants	71 each

Summarizing the capacity of a distribution system is difficult since it has as many capacities as it has locations within the network. The Milford system, nevertheless is generally adequate hydraulically (problems are related to leakage rather than hydraulics) for the current population. The peak instantaneous demand is estimated at 1.8 gpm per connection (Hughes and Gross, 1979) or 828 gpm total for the system. The 12" main line has the capacity to deliver at least 2,000 gpm at a reasonable head loss, and therefore is more than adequate. The 8" lines can deliver about 800 gpm and the 6" lines at least 350 gpm. The central locations of the reservoirs within the distribution network divides the outflow into several different pipes rather quickly, and therefore very substantial growth could be accommodated with no change to the distribution system other than extension of lines to the new areas. The storage and pump capacities are much more limiting than the distribution mains.

4. Hydraulic, Hydrologic, and Economic Implications of Major Growth.

a. Population Projection: Recent population projections for Milford vary over an extremely wide range depending upon the future of a proposed aluminum mining operation (Alunite). For example, the Kaiserman report (1978) recommends water and sewer facilities to handle a population of 6,000 by 1982, the initially scheduled year for full operation by

Alunite. The Five County 208 study projects a lower population limit for 1985 of 1518 (essentially no growth) and an upper limit of 7,278 (with Alunite). Because of a drop in aluminum prices and other economic factors, the Alunite Consortium has now been dissolved, and therefore this major impact will not be included. The population assumptions for this study are:

Year	Population	Situation
1980	1,500	Existing
1987	2,000	4%/yr Growth without MX
1987	14,500	12,500 from MX at construction peak
1995	9,100	6,600 Permanent from MX

b. Projected Water Demand: It would be difficult for Milford to convert to a metered system during normal growth conditions because the existing families would in effect have to pay for the meters with no immediate or apparent benefit. However, if MX related growth is very large and very rapid, it would be very foolish not to meter what would become essentially a major new water system (only about 10 percent of the 1987 population would be associated with the existing system). Therefore the projected water use rates per person will be assumed as identical to existing levels (401 gpcd average and 874 gpcd peak) under the "without MX" scenario but reduced to 290 gpcd average and 674 gpcd peak day with MX. These revised quantities are based upon current use in metered energy impacted areas (many mobile homes) in Utah counties with a similar hot and dry climate. If the cost of water becomes very high due to the expense of developing the large amounts of extra water required, use rates would be substantially lower. An alterate assumption that will be used here is that groundwater will continue to be available at reasonable costs (no treatment other than chlorination) and that federal "impacted area" type subsidies will become available to maintain water prices at a level close to that in non-impacted communities in the region.

The projected water system capacities, supply levels, and water right requirements are shown in Table 7 along with a summary of existing flows and capacities which were discussed previously.

c. Conclusions: The Milford system currently has inadequate reservoir storage, a minor excess capacity of production facilities (wells and pumps), a distribution system which is adequately sized but which experiences considerable leakage, and an established water right to more than double the current peak demands.

If MX is not built (or does not impact the Milford area) the existing system would be adequate in 1987 except for needs to increase storage and peak day pumping capacity. The City is currently proceeding with plans to construct additional storage and drill and equip an additional well to meet these needs.

If, however, the projected MX growth of 12,500 population increase occurs, an almost entirely new system will be required. The distribution system and storage can be provided with no special problems if impacted-area funding is properly administered. The necessary increase in well capacity, however, from 2.85 mgd to 10.7 mgd on peak summer days and the water rights to pump these wells is a different matter. No additional water is available for appropriation in this valley. The groundwater is in fact being mined under present over-appropriated conditions. There is no point in buying local surface water from other users since it would require costly treatment. The only economically feasible method of securing the additional water is to purchase existing groundwater irrigation rights from local farmers and either reduce agricultural production

Table 7. Summary of Milford water system existing and projected capacities.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
Present Use	1500 (460 conn.)		(Basis = 400 gpcd Avg and 874 gpcd peak day)		(Basis = 1.8 gpm per conn.)
Average			0.60 mgd		
Peak Day			1.30 mgd	0.31 mg	
Peak Hour					828 gpm
Present Capacity		2240 gpm (Total) 1978 gpm (Residential)	3 ea @ 420 gpm but 90% use factor	Should have 0.37 mg (Basis = 800 gal/ conn.--fire flow from pumps)	Basis = 12" Main Line
Average		2.85 mgd	1.63 mgd		
Peak Day		2.85 mgd	1.63 mgd	0.31 mg	
Peak Hour		1978 gpm	1260 gpm		2000 gpm
Required Capacities in 1987 Without MX (Also without any other major impact such as Alunite)	2,000 (613 conn.)		Basis = 400 gpcd avg, 874 gpcd peak, and 90% use factor on peak day	Basis = 55,000 gal fire flow (Balance from wells) Plus 800 gal/conn.	Basis = 1.8 gpm per conn.
Average		0.89 mgd			
Peak Day		1.94 mgd	1.94 mgd	0.55 mg	
Peak Hour			N/A (only daily avg required)		1100 gpm

Table 7. Continued.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
<u>Required Capacities 1987 With MX</u> (Without other major impacts)	14,500 (4500 conn.)		Basis = 290 gpcd avg, 674 gpcd peak day and 90% use factor on peak day	Basis = 500 gpm per conn. (minimum land-scaping for construction period) fire flow from wells	Basis = 1.7 gpm per conn.
Average		4.2 mgd			
Peak Day		10.7 mgd	10.7 mgd	2.25 mg	
Peak Hour			N/A		7650 gpm

or retire some irrigated land from use. The amount of water allowed by the State Division of Water Rights for irrigation in this area is approximately 4 acre feet annually. However, part of this water returns to the aquifer by deep percolation and is thought to be a major source of groundwater recharge. The State Engineer has therefore taken the position in similar nearby areas that only 2.5 acre feet per acre of land (the estimated depletion fraction of the total diversions) will be allowed to be converted to the new use. This would likely be the ruling in Milford if either conventional sewage treatment or lagoon type treatment (the current approach) is used to treat the municipal wastewater. The full 4 acre feet should be allowed if land application of sewage is used.

Since the most probable sewage treatment method is lagoon containment, 2.5 acre feet per acre of irrigated land will be assumed as the amount of water which can be obtained with a change of use from irrigation to municipal. The change in timing of the pumping should be a benefit rather than a problem. The irrigation use occurs from April to October while the municipal use is spread over all 12 months, thereby decreasing the relative peak period pumping rate from the aquifer.

It will be necessary to acquire an additional 1.35 mgd average flow water right and well production facilities to handle the assumed MX related growth. This amounts to 1516 acre feet per year. Under the assumption outlined above, this will require either removal from production of 606 acres which now have a full water right or reduced yields from a larger acreage--for example 1516 acres if 1 0 a.f./acre can be purchased. These figures are based upon average annua quantities and perhaps understate the problem in regard to summer peaks. Furthermore, the State Engineer would have to approve peak day pumping rates of 10.7 mgd as compared to the 4.2 mgd average rate. The 10.7 mgd amounts to a 16.6 cfs flow rate and the existing wells are pumped at about 1 cfs each. This implies either a large number of similarly sized new wells or a smaller number of very large wells which could cause large local drawdown and interference with existing irrigation wells. It may therefore be necessary to locate the new wells well outside the City boundary and construct long transmission lines; or depending upon the location of purchased irrigation rights--some existing wells may be suitable (after proper grout sealing) for conversion to municipal use. The latter may be more reasonable for water that would only be temporarily needed during MX system construction.

II. Delta City

1. Water Source.

The entire water supply for Delta is groundwater pumped from three currently operating wells. The City has a total water right of 4.255 cfs which has been established from an accumulation of five previously developed wells--two of which are no longer operated. The City's wells and storage tasks are located in Figure 6. The currently operative wells are equipped as follows:

Well	Dia.	Depth	Pump Capacity	Water Right and Use
1. Sugar Factor Well	12"	730'	360 gpm	
2. At Elevated Tank	12"	860'	596 gpm	4.255 cfs
3. 3rd W. & Main	20"	856'	1150 gpm	Municipal Use
		Total Capacity	2106 gpm	(1910 gpm)

2. Current Water Usage.

The population of Delta (Kaiserman Associates, 1979) is estimated at 2,100, and the water system has 775 connections (2.7 persons per connection).

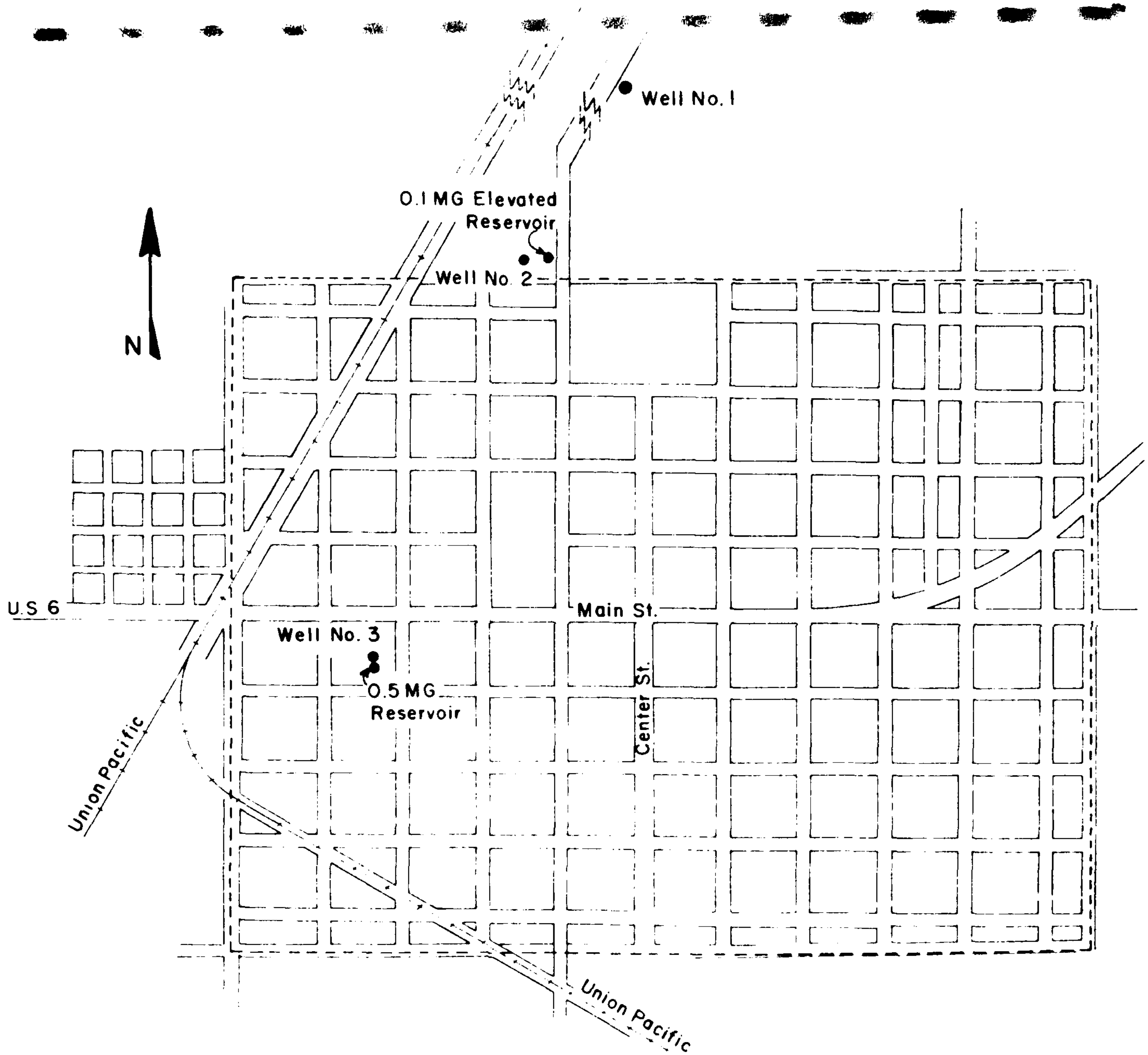


Figure 6. Delta water system well and storage location map.

Recent water use (1976, 1977, and 1978 average) based upon total production from the three wells is given in Table 8. The data indicate daily per capita uses rates (gpcd) of 238 average and 521 during the peak month. The peak day functions of Hughes and Gross (1979) suggests 546 gpcd as a peak day estimate (1.15 mgd for the current population of 2100). This is only slightly greater than the measured peak monthly rate but is considered adequate because the peak month figure in the table is of questionable validity (June rather than the usual July or August peak) and may have resulted from some extraordinary use such as a large fire or line break.

3. Maximum Capacity without Changing System

a. Source and Treatment Facilities: The present groundwater supply is of excellent quality and requires no treatment whatever. No

Table 8. Average 1976-78 water use by Delta City.

	Total (mg)	Daily Average Gallons)	
		Per Conn.	Per Person
January	7.30	304	113
February	8.79	405	150
March	10.45	435	161
April	16.70	718	266
May	18.21	758	281
June	32.71	1407	521
July	25.52	1062	393
August	23.69	986	365
September	11.22	536	199
October	13.67	588	218
November	4.72	203	75
December	7.23	301	111
Total	180.29		
Average	15.02	642	238

future treatment is anticipated. The existing pump capacities and water rights are detailed in the water source section. The total water right (1910 gpm) is slightly less than the existing total capacity of the pumps (2106 gpm) if all three were operated continuously (which they could not be for any extended period). With a 90 percent use factor, the pump capacity is 1895 gpm or 2.73 mgd, more than twice the amount required by the current peak day demand of 1.15 mg.

b. Storage Facilities: The existing finished water storage consists of an elevated 100,000 gallon steel tank and a ground level 500,000 gallons steel tank. The elevated reservoir maintains the system pressure while the larger tank requires a booster pump for its outflow. The Kaiserman Associates report (1979) recommends a storage capacity of 800 gallons each for 775 connections or 620,000 gallons plus a 2-hour fire flow at 2500 gpm or 300,000 gallons. The total of 920,000 indicates a shortage of 320,000 gal. (35 percent).

c. Distribution System: Kaiserman gives the following summary of distribution pipe line lengths by size:

Diameter	Length	Materials
Under 4"	9,350	
4"	33,800	A Mixture of Cast
6"	23,650	Iron, Asbestos
8"	19,750	Cement and PVC
10"	3,300	
	89,850	

The estimated peak instantaneous flow into the distribution system is 1.8 gpm per connection or 1395 gpm. The separate 10" mains serving each reservoir have a capacity of about 1500 gpm each (3000 gpm total) and the smaller lines appear to be sized with similarly generous capacity the trunk lines in the existing distribution system could thus serve considerable growth.

4. Implications of Major Growth.

a. Population Projection: The population of Delta City has grown 2.2 percent annually during the last decade. Population growth is expected to increase dramatically as the Intermountain Power Project (IPP) is constructed. Superimposing major MX-related growth upon the IPP impact (both of which are scheduled to peak in about 1987) would cause the population to increase more than seven fold in seven years. Since many of the geo-technically suitable MX facility locations are near Delta, a total population of 12,500 (of a statewide total of 30,000) will be assumed to move into the general area of Delta (but not all into Delta City). For estimating the probable impact on water facilities, recent Kaiserman Associates reports on Delta City and the nearby towns of Hinckley, Deseret, Oasis distribute the total IPP population impacts among these towns (see Figure 7 for relative locations). This same distribution (82 percent or 10,250 within Delta) will be used here for the distribution of MX related growth. The resulting population assumptions are as follows:

b. Projected Water Demands: Present per capita water use in Delta (which is completely metered) is below the statewide average. An

Table 9. Projected population for Delta City.

Situation	1980	1987	1995
Growth without IPP and MX	2,100	2,800	
Growth with IPP but without MX	2,100	5,300	
Growth with both IPP and MX	2,100	15,550	10,350

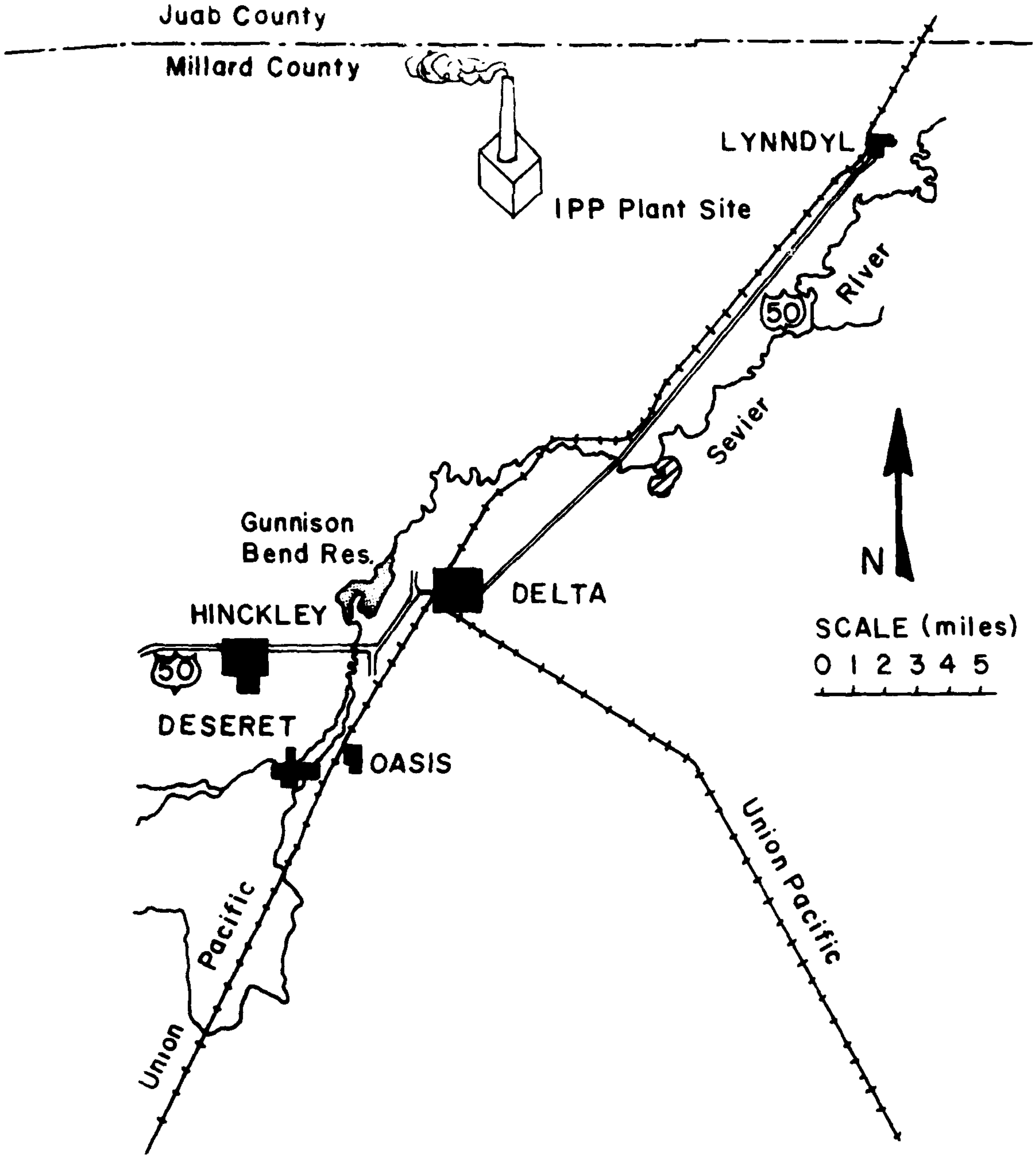


Figure 7. Delta region site map.

even lower use rate may be possible in the future due to increased water charges and to less landscaped area per temporary family during the MX construction period; however, such a decrease is expected to be rather minor and current use levels of 238 gpcd average and 546 gpcd peak will therefore be used for future projections.

c. Conclusions: The Delta water supply system is presently adequate in terms of water rights, deepwell and pump production capacity, and main line distribution system capacity. It has in fact more than 100 percent excess capacity during current peak days. The one inadequacy is in finished water storage. Present storage is adequate for residential and industrial peak period demand but not for fire protection.

The existing system should still be adequate by 1987 assuming IPP is constructed but MX is not (or has no impact upon Delta) in terms of water rights and production facilities. Population growth from 2100 to 5300 will obviously require additions to the distribution network to serve new areas. Whether or not the existing main lines prove adequate depends upon the location of the growth in relation to existing major supply lines. Storage capacity will require an increase from 0.6 mg to 1.5 mg. These projected quantities, along with existing use rates and capacities are summarized in Table 10.

If the 10,250 MX-related population growth is superimposed upon the projected IPP growth in Delta, the existing facilities are entirely inadequate. Delta will be faced with a population expansion from 2100 to 15,550 during a period of 7 years. All of the existing system components will become completely inadequate, and required system expansions will include a 200 percent increase in peak day production, a 400 percent

Table 10. Summary of Delta water system existing and projected capacities.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
Present Use (1980)	2100 (775 conn.)		(Basis =238 gpcd avg and 546 gpcd peak day)		Basis = 1.8 gpm per conn. total res. outflow
Average			0.50 mgd		
Peak Day			1.15 mgd	0.60 mg	
Peak Hour			2106 gpm		1395 gpm
Present Capacity (1980)			(Basis = 90% use factor on pumps)	Recommendation = 0.92 mg (Presently 35% shortage)	Basis = (2) ea 10" Mains
Average		2.75 mgd	2.73 mgd		
Peak Day		2.75 mgd	2.73 mgd	0.60 mg	
Peak Hour		1910 gpm	2106 gpm		3,000 gpm
Required Capacities (1987): With IPP, Without MX	5300 (1960 conn.)		Basis = same as present gpcd above and 90% use factor	Basis = 700 gal/conn. Plus 105,000 gal fire flow from res.	Basis = 1.7 gpm per conn.
Average			1.13 mgd		
Peak Day			2.60 mgd	1.5 mg	
Peak Hour			N/A		3330 gpm

Table 10. Continued.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
Required Capacities (1987) With Both IPP & MX	15,500 (5770 conn.)		Basis = same as above	Basis = 500 gal/conn. (fire flow from wells)	Basis = 1.6 gpm
Average			3.7 mgd		
Peak Day			8.5 mgd	2.9 mg	
Peak Hour			N/A		9,230 gpm

increase in storage, and a 200 percent increase in main line distribution capacity. These capital investments can be provided in time only with major federal impact type subsidies.

The additional water right requirement on an annual volume basis would be 0.95 mgd or 1070 acre feet per year. Since Delta is in an already over appropriated groundwater basin, the only possible way to acquire this water is to purchase existing rights from irrigated agriculture. The maximum amount per irrigated acre which a holder is allowed to sell is the depletion amount which has been established by the State Engineer at 2.5 A.F./acre. In order to purchase the needed water, either 428 acres will have to be taken completely out of production or some larger number of acres will experience decreased yields (1070 acres for example if farmers were willing to sell 1.0 A.F./acre) because of fractional sales. The second method may be more reasonable for water which can later be returned to agriculture after the MX construction boom.

The well interference impact on the local groundwater aquifer during summer months will be much greater than that implied by the 1157 A.F. of additional average annual pumping by the City. For example, the Delta City total peak day pumping rate would increase from 1.15 mg currently to 8.5 mg (800 to 6040 gpm) by 1987. Existing wells vary from 360 to 1150 gpm capacities each. Therefore several major new wells will be needed, and interference considerations will require that they be located substantial distances outside of the City. The ideal way to avoid legal difficulties with Third-party water users would be to purchase existing wells from irrigators and to continue to pump them near existing pumping rates. There are several difficulties associated with this concept, however, including: 1) irrigation wells usually do not meet the sanitation and gravel packing standards for a good municipal well; 2) the water right purchases may consist of a large number of partial rights from many scattered irrigators, and 3) the irrigation-well owners who are willing to sell their water may be located at long distances from the City.

An additional economic problem related to acquiring rights in Delta is that recent IPP water purchases from farmers in that region have eliminated the "excess" rights held by most farmers and have caused an explosive increase in water costs. Recent IPP purchases were made at $1,750/AF. At this price, 1157 AF would cost Delta City $2 million. The City should be able to find water at a somewhat lower price now that IPP has completed its purchases, but still that recent precedent is bound to maintain an extremely high water cost.

III. Cedar City

1. Water Source.

Cedar City presently obtains its water supply from a combination of 6 wells and 14 springs--locations are given by Figure 8. Two of the wells are very small and are used only for irrigation-spring flow exchanges and therefore aren't shown in Table 11. The city also has purchased water rights to considerable surface water from Coal Creek, which is presently used for irrigation but which could be treated for future culinary use. Cedar City also has a right to 2,000 acre feet annually of water from Kolob Reservoir and is considering expansion of that right to 5,000 a.f. None of the local stream or reservoir water that Cedar City has obtained by purchasing these rights is usable in the culinary system until suitable treatment facilities are installed and a long transmission line is constructed from Kolob Reservoir. Only currently used springs and wells are included in the water rights summary in Table 11.

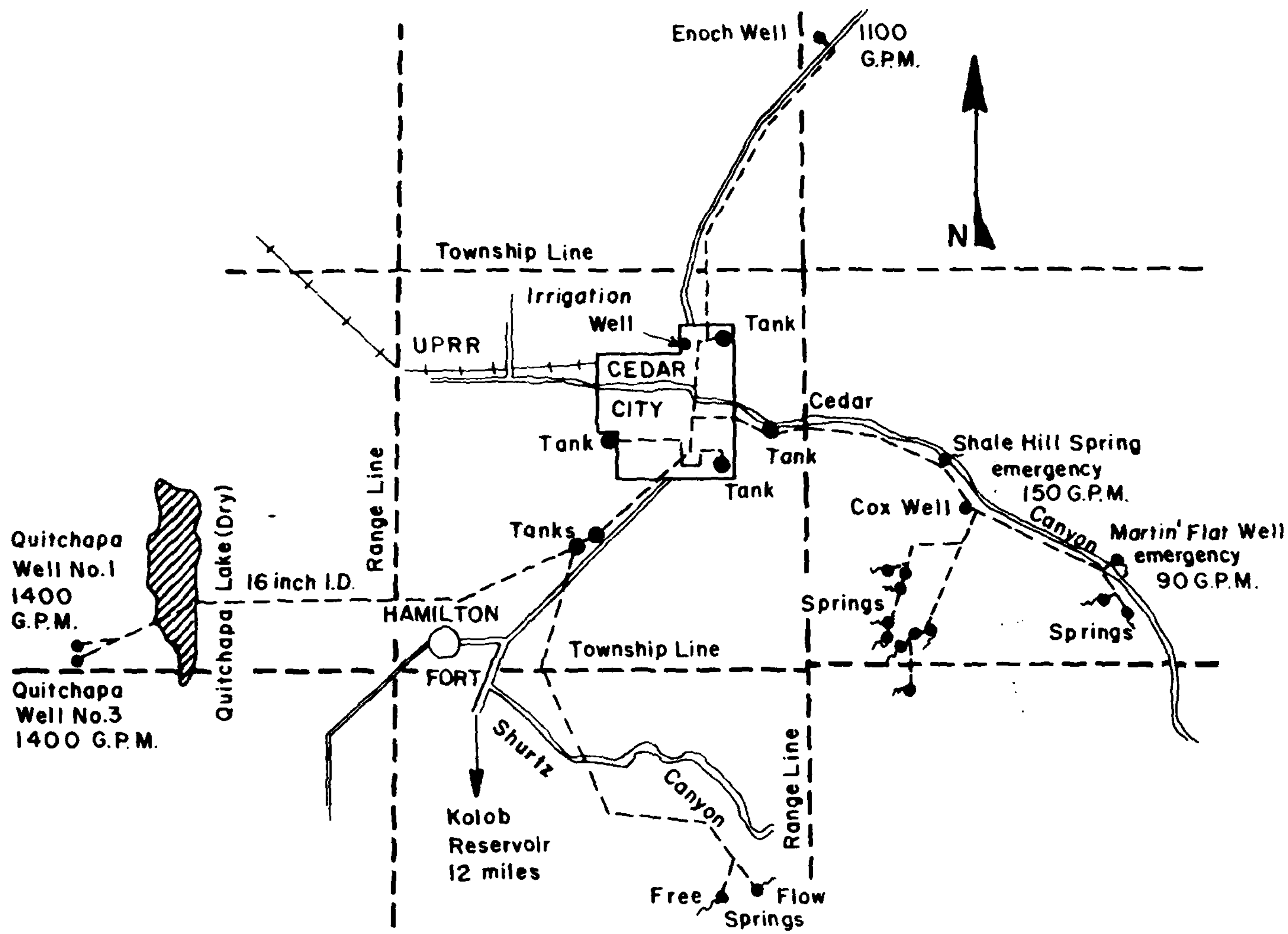


Figure 8. Cedar City existing water system.

Table 11. Cedar City well and spring 1979 production and capacities (Bulloch, 1979).

Facility	Avg. Production (gpm) Jan.	July	Yr.	Peak Capacity (gpm)	Remarks
1. Cedar Canyon Sources	558	788	739	788	12 springs
2. Shurtz Canyon	315	621	467	621	2 Springs
3. Old Enoch Well	0	653	242	1100	5 Miles North of City
4. Quitchapa Well #1	0	356	62	1400	10 Miles SW of City
5. Quitchapa Well #3	166	1217	507	1400	10 Miles SW of City
6. Cemetery Well	0	(933)	(204)	(1700)	Irrigation Only--Quality Unsuitable for Culinary
Culinary Only Totals (gpm)	1039	3635	2017	5309	
(mg)	46	162	1057		

The City's water rights combine: 1) "cfs" rights which are either spring or well rights which can be used continuously at the stated flow rate, and 2) "AF" rights which have been mostly acquired from irrigators and therefore are limited to a maximum annual volume. This combination makes characterization of maximum flow rates somewhat ambiguous, but the working assumption for this study will be that the "cfs" rights (which total 7.0 cfs) provide a continuous base flow right upon which the effective "AF" rights (totalling 2,432.3 A.F.) will be superimposed at a constant rate during a 120-day peak summer season. The actual rate of use of the "AF" right could of course be varied to meet demand during unusual peak days as constrained only by pump and transmission capacities. Using the constant 120-day distribution of "AF" rights, however, gives a maximum water right capacity of 10.2 cfs for a total flow rate of 17.2 cfs or 7723 gpm (Bulloch, undated).

2. Current Water Usage.

The population of Cedar City is estimated at 13,000 for 1979. The City had a total of 3116 water service connections (4.17 persons/conn.). Water use during recent years is summarized in Table 12. The cemetery well was converted from culinary to irrigation purposes during 1976, and total quantities shown after that year do not include production from that well (which is now used for irrigating the cemetery, the college, the high school and the golf course).

The per person annual water use rate is currently 223 gpcd, and the peak day rate is 517 gpcd. The Utah peak day function (Hughes and Gross, 1979) predicts 509 gpcd for the peak day and thus agrees very closely with the measured 1979 rate for Cedar City.

3. Maximum Capacity Without Changing System.

a. Source and Treatment Facilities: The present spring and well water (except for the irrigation well) is of adequate culinary quality

Table 12. *Total historic culinary system water use.*

Year	No. of Connections	Total Use (mg)	Average Daily Use (gpcd)	Peak Day (mg)
1973	2458	934.5	250	6.2
1974	2567	984.9	252	6.8
1975	2675	953.4	234	6.1
1976	2812	1,037.5	242	6.3
1977	2940	816.2	182	5.3
1978	3015	831.0	181	5.9
1979	3116	1,057.4	223	6.7 (4652 gpm)

without treatment. No future treatment is anticipated until growth requires surface water sources to be introduced into the system. The present peak-period water rights totalling 7723 gpm are substantially greater than the 1979 peak-day demand of 4652 gpm. The existing physical facilities, however, are only able to produce 5309 gpm from the springs and wells, and this amount is only 14 percent more than the 1979 peak demand.

b. Storage Facilities: The finished water storage facilities consist of 7 reservoirs which total 8.5 mg. The residential demand storage recommendation for Cedar City is approximately 700 gallons/conn. or 2.2 mg. Much of the yard irrigation is provided by a separate ditch system and all of the major community irrigated areas (cemetery, college, high school, and golf course) are served by a separate pressure irrigation system. The recommended fire flow is 5.04 mg (10 hour fire @ 3500 gpm). Because of the remote location of the well sources it is desirable to furnish the fire flow (except possibly dependable spring flow) from storage near the distribution system rather than from direct pumping. This indicates a recommended total storage of 7.2 mg. The existing storage therefore represents 18 percent excess capacity.

c. Distribution System: The City Engineer gives the following summary of distribution pipelines by size:

WATER MAINS IN CEDAR CITY LIMITS (FEET)

Size	1977	1978	1979
2"	18,325	18,325	17,945
3"	11,767	11,767	11,767
4"	91,471	92,411	93,248
6"	81,459	93,444	111,454
8"	28,877	29,502	29,972
10"	33,262	33,872	39,262
12"	11,433	11,433	11,433
16"	2,549	2,549	2,549

WATER MAIN OUTSIDE CITY LIMITS

Approximately 36.77 miles

The total peak-hour demand below the reservoirs is estimated at 5600 gpm. This flow enters the city through three major reservoir outlet pipes (north, east, and south of City). Therefore, the single largest pipe flow should not exceed 2000 gpm (which could be handled by a 12" pipe). It appears, therefore, that no hydraulic limitations will be imposed by the principal distribution mains prior to very substantial growth.

4. Hydraulic, Hydrologic, and Economic Impacts of Major Growth.

a. Population Projection: The growth of Cedar City has been very rapid during recent years. The principal impact assumed during most future projections is from the proposed Alunite project. Since that project now appears to be abandoned, the high growth rate used for the area's 208 Plan will not be used here. Rather, the 208 lower growth rate corrected for a 1979 base population of 13,000 will be used. Since most of the suitable locations for MX storage facilities are located closer to Milford and Delta than to Cedar City, only an MX construction period peak population of 5,000 will be assumed. Superimposing this amount on the lower 208 projections gives:

Year	Population	No. of Connections	Situation
1979	13,000	3116	Existing
1981	14,900	3590	Without MX
1987	19,900	5260	With MX (5,000 constr. Peak)
1995	18,940	4730	Permanent MX (2640)

b. Projected Water Demands: The per capita water use in the Cedar City municipal system is currently relatively low compared to that in other Utah communities in such a hot, dry climate. This is partly due to the relatively high cost of water (additional groundwater is not locally available and surface supplies will have to be mostly imported and treated) and to the fact that about 50 percent of the residential gardens and 10 percent of private lawns are served from a separate ditch irrigation system and almost all of the public irrigated areas (the cemetery, college, high school, and golf course) are served from a separate pressure irrigation system. A larger part of the future growth will be in areas not served by the ditch or pressure irrigation systems, and this factor will tend to increase per capita use rates. On the other hand, several factors that will tend to decrease future per capita use include: 1) mobile home residences for many MX construction workers, 2) a general trend toward multiple dwelling units, and 3) a trend toward desert type landscaping which minimizes irrigation. The assumption used here is that these counteracting influences approximately balance and that projected use rates can reasonably be taken at their present values of 223 gpcd average and 517 gpcd on peak day.

c. Conclusions: The Cedar City water supply system is adequate for the existing demand but only by a small margin on peak day (14 percent). By 1987 under normal growth conditions the system will still be adequate except during a few peak days and for distribution laterals serving heavy growth areas. Under this "1987 without MX" situation, 1) the existing water rights appear to be adequate for both average condition (48 percent excess capacity) and peak day condition (25 percent excess capacity), 2) the production facilities total capacity (average annual spring flow plus wells at 90 percent use factor) will be almost double the average demand but an 8 percent shortage will occur during peak days even if wells are pumped 100 percent of the time (a dangerous assumption), 3) the storage capacity should still be adequate but very near the recommended limit. These quantities as well as "with MX" estimates are summarized in Table 13.

The situation for "1987 with MX" is 1) the average flow water rights are adequate but the system is on the borderline of not being able to supply needs during peak periods. The summer 120-day period rights total 11.13 mgd while the peak day requirement (11.23) slightly exceeds this; 2) the capacities of the spring and well system will be adequate for average conditions but not during peak days (a 32 percent shortage); 3) the storage facilities will need to be increased by only 10 percent; and 4) the distribution system will need to be expanded in areas of major growth but existing main lines should require only modest expansion.

Cedar City has adopted a policy of purchasing any water rights which become available in their area. This is obviously a wise policy and has resulted in a capability to handle significant growth (from 13,000 to 20,000 population in this projection) without an emergency type situation. The additions of a treatment plant for surface water from Kolob Reservoir and Cedar Canyon is considered to be a long range future supply (lengthy negotiations and an additional reservoir for an exchange of Kolob water are required). Therefore it is assumed that additional groundwater development (3.59 mgd) will be required to meet MX related demands by 1987. This can likely be accomplished with only two additional wells. The City recently passed a $3 million bond issue for the purpose of doubling the pumping and distribution capacity. Successful completion of that program will result in a system capable of handling the projected MX related growth.

IV. Hinckley, Deseret, and Oasis

1. Water Sources.

These three small communities are located 5 to 6 miles west and south of Delta. Hinckley, population 500, is the only town with a public

Table 13. Summary of Cedar City water system existing and projected capacities.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells & Springs)	Storage (Finished Water)	Distribution System
Present Use (1979)	13,000 (3116 conn.)		(Basis =223 gpcd avg and 517 gpcd peak day)	(7 Reservoirs)	Basis = 1.8 gpm per conn. total res. outflow
Average			2.90 mgd		
Peak Day			6.71 mgd	8.5 mg	
Peak Hour					5600 gpm
Present Capacity (1979)		*Basis = A.F. Type Rights During 120 Days	*(Basis = 1.7 mg springs + 5.0 wells)	(Presently adequate)	Basis = 16" & 12" Mains
Average		6.70 mgd	6.7* mgd		
Peak Day		11.13 mgd*	7.64 mgd	8.5 mg	
Peak Hour		7,728 gpm*	8,913 gpm		9,000 gpm
Required Capacities (1987): Without MX	14,900 (3590 conn.)		Basis = same as present gpcd above and 90% use factor on wells	Basis = 700 gal/conn. Plus 5.5 gal fire flow from res.	Basis = 1.8 gpm per conn.
Average			3.5 mgd		
Peak Day			8.37 mgd	8.0 mg	
Peak Hour			N/A		6462 gpm

Table 13. Continued.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells & Springs)	Storage (Finished Water)	Distribution System
Required Capacities (1987) With MX	19,900 (5260 conn.)		Basis = same as above	Basis = 500 gal/conn. plus 6.0 mg fire flow from res.	Basis = 1.7 gpm
Average			4.74 mgd		
Peak Day			11.23 mgd	9.4 mg	
Peak Hour			N/A		8,940 gpm

water system. Deseret and Oasis, populations 221 and 173, currently have no public system (individual private wells are used). The three communities will be discussed together here in regard to their future water system plans, needs, and MX impacts because of their 1) close proximity, 2) sharing a common groundwater quality problem--arsenic levels which exceed allowable limits, and 3) joint effort underway to construct a regional water system to serve all three communities. Both arsenic levels and the proposed regional well location are shown in Figure 9.

Hinckley has a single well which supplies the municipal system. The water right associated with this well is 0.67 cfs. The well is 12" diameter and 745' deep. In addition to this public water right, some individuals in all three communities have private wells with associated private water rights that could be transferred to a regional system. Kaiserman Associates (1979) report these totals as follows:

Water User	Water Rights (cfs)
Hinckley Municipal	0.67
Hinckley Private	2.28
Deseret Private	1.01
Oasis Private	0.80
	4.76 cfs

2. Current Water Usage.

The Hinckley municipal system presently delivers an average of only 107 gpcd and 172 gpcd during peak days. These quantities, however, do not represent the total residential use since many individuals supplement what they purchase with water from private wells. Water usage in Deseret and Oasis is unknown since it is entirely from private wells. Projected water use rates for this region will be based upon the Delta City levels of 238 gpcd avg. and 546 gpcd peak day.

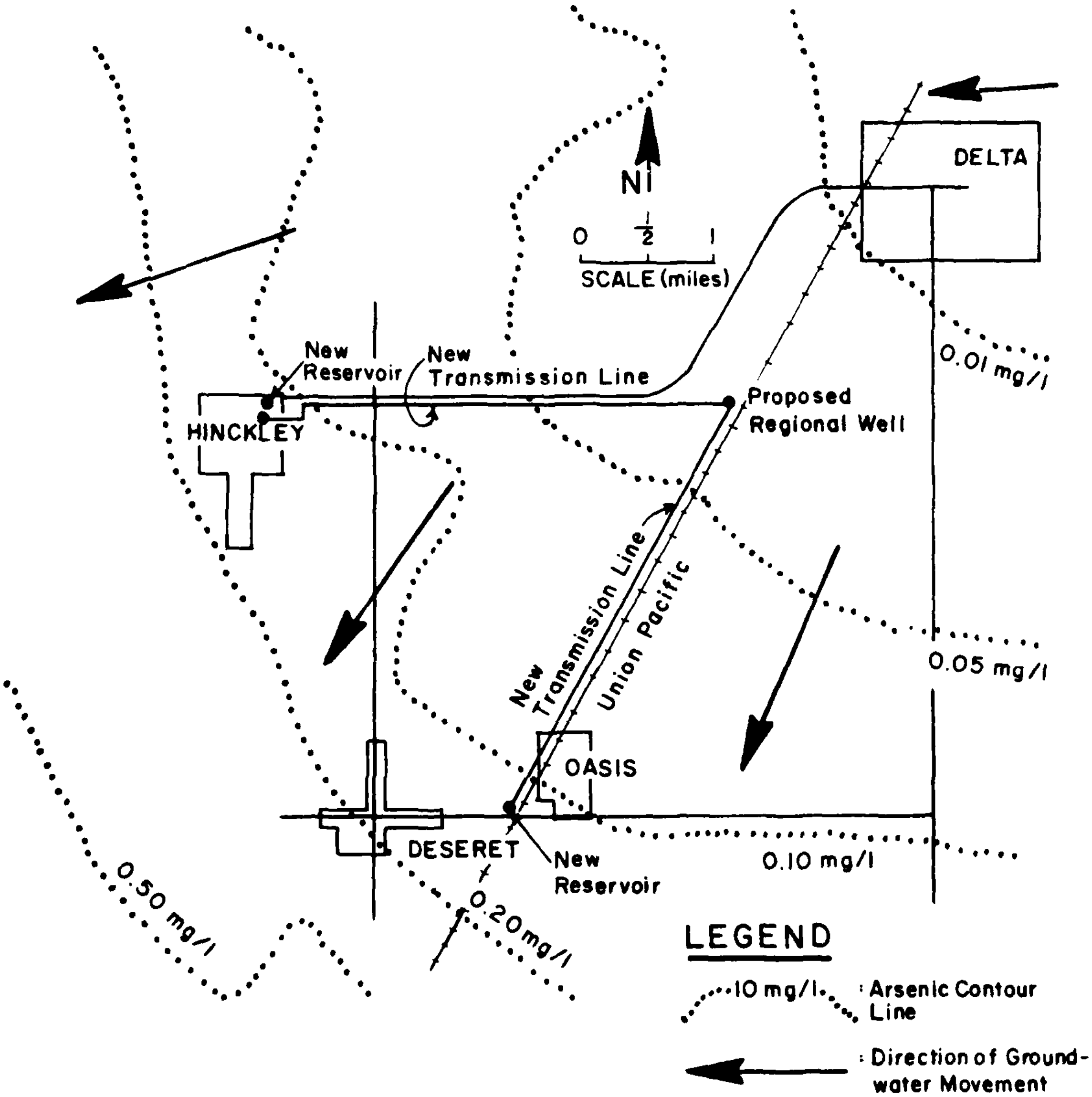


Figure 9. Arsenic levels in groundwater and proposed regional water system.

3. **Maximum Capacity Without Changing the System.**

The Hinckley municipal well is equipped to pump at a maximum rate of 200 gpm. This facility has hydraulic capacity to serve 1600 persons at current peak day use level of 527 gpcd at projected (Delta City) use levels. However, the well produces water with an arsenic level which has increased from just below the allowable limit of 0.05 mg/l at the time of initial operation in 1967 to over three times that limit (0.16 mg/l) in recent years. It therefore should not be relied upon for future supply without treatment.

The Hinckley storage reservoir is a 100,000-gallon ground level tank with a booster pump. Because the irrigation water in town is supplied by other sytems, the storage requirement is only 400 gal./connection or 60,000 gallons for the 150 existing connections. The recommended fire requirement is 150,000 gallons of which one third can be supplied from wells. If 100,000 gallons of storage are for fire control, the total storage requirement is 160,000 gallons or 60,000 gallons more than currently available.

The distribution network consists of 6" and 4" pipes except for smaller lines serving isolated families without fire protection. The 6" main line capacity is approximately 500 gpm (PVC pipe). Which is considerably more than existing peak demand except during a major fire.

4. Implication of Major Growth.

a. Population Projection: Both [illegible] and MX will have substantial impact on this region (both of which are assumed to peak in 1987). The assumption used here will be that 18 percent of the population growth in the region will occur in the tri-city area while the balance will occur in Delta. Kaiserman Associates (1979) projections are used for the non-MX growth with the results shown in Table 14.

b. Conclusions: The existing Hinckley system and projected three-community capacity requirements are summarized in Table 15. The existing distribution system and storage reservoir in Hinckley will be usable, but will both require major expansion for MX and IPP related growth.

The Kaiserman Associates report discusses the problem caused by naturally occurring arsenic and suggests increasing production from the existing well and treating the water to remove arsenic. This alternative, however, is more expensive than developing a new regional well north of the three communities (in a low arsenic area) and constructing transmission lines to the three service zones. It will be assumed therefore that the existing Hinckley well will be maintained only for standby emergency operation and that a new regional well or wells of 1500 gpm capacity will be constructed. A new 3.6-mile transmission line to Hinckley and 3.4-mile line to a Deseret/Oasis reservoir will then be required. Complete new distribution systems (8" maximum diameter) and a 0.62 mg storage reservoir will be required to serve Deseret and Oasis.

Table 14. Projected population for the Hinckley-Deseret-Oasis area.

Situations	1980	1987	1995
Growth without IPP and MX (Kaiserman)	925	1050	1160
Growth with IPP but without MX (Kaiserman)	925	1600	1410
Growth with IPP and MX	925	4000	2700

Table 15. Summary of Hinckley existing water system and projected Hinckley, Deseret, and Oasis capacity requirements.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
Present Use (1980)	500 (Hinckley only) (152 conn.)		(Basis =107 gpcd avg and 172 gpcd peak day)		Basis = 1.8 gpm per conn. total res. outflow
Average			0.05 mgd		
Peak Day			0.09 mgd	0.10 mg	
Peak Hour			200 gpm		274 gpm
Present Capacity (1980)		Basis - Hinckley Municipal Only	(Basis = 90% use factor on pumps)	Recommendation = 0.16 mg (Presently 35% shortage)	Basis = 6" Main
Average		0.43 mgd	0.26 mgd		
Peak Day		0.43 mgd	0.26 mgd	0.10 mg	
Peak Hour		300 gpm	200 gpm		500 gpm
Required Capacities (1987): With IPP, Without MX	(All three communities) (490 conn.) 1600 population		Basis = 238 gpcd avg and 546 peak (90% use factor)	Basis = 600 gal/conn. Plus 0.9 mg gal fire flow from res.	Basis = 1.8 gpm per conn.
Average			0.38 mgd		
Peak Day			0.87 mgd	1.2 mg	
Peak Hour			N/A		882 gpm

Table 15. Continued.

Item	Population & Number of Connections	Water Rights	Production Facilities (Culinary Wells Only)	Storage (Finished Water)	Distribution System
Required Capacities (1987) With Both IPP & MX	4,000 persons (1220 conn.)		Basis = same as above	Basis = 600 gal/conn. (fire flow from wells)	Basis = 1.7 gpm per conn.
Average			0.95 mgd		
Peak Day			2.18 mgd	1.40 mg	
Peak Hour			N/A		2,074 gpm

No additional water rights will be required if sufficient individual rights now owned by users in the three communities can be acquired by the regional utility. It will be necessary to acquire 0.80 cfs of such rights (only 20 percent of the existing individual well rights in the three communities).

V. Garrison

The 60 people (approximately 15 families) of Garrison, located in Snake Valley near the Utah-Nevada border, have no public water system. Private wells are used for residential water supply.

This area, however, has good potential for groundwater development. Contrary to the situation in the more densely populated valleys further east, the Snake Valley has groundwater in substantial amounts available for appropriation without decreasing agricultural production. The quantities required to support MX related growth could likely be obtained in this area with much less impact to existing water users than in the Delta, Milford, or Cedar City areas. For example, if one half of the 30,000 Utah MX construction induced population increase occurred in this region, the annual municipal water demand (at 230 gpcd) would be 1260 mg or 3,880 acre feet. The peak day pumping capacity (at 526 gpcd) would be 5,480 gpm and could be readily supplied by four wells of 1400 gpm capacity which, if properly located, would have no adverse hydrologic impact on the aquifer.

Of course since no municipal water system now exists in the area, all wells, storage reservoirs, and distribution pipes would have to be built from scratch. This would require substantial investment. Furthermore, there is no existing institution to take charge of the expansion. All necessary design and implementation would have to be done through the MX project.

WASTEWATER SYSTEMS

I. Milford City

1. Existing Collection and Treatment Systems.

a. Collection System: Kaiserman Associates (January 1978) prepared preliminary water, sewer, and storm drain plans for Milford City. The entire city, with few exceptions, is served by the existing sewer collection system summarized in Table 16. The lines are vitrified clay type with oakum and/or mortar joints. The pipe seems to be in fair condition. The joints are in poor conditions, and many are penetrated by roots.

Some of the sewers were constructed over 100 years ago. The existing collection system violates several present Utah Division of Health Code of Water Disposal Regulations. Violations include mainlines constructed on inadequate grades (0.0106 percent), cracking and material breakdown of the sewer lines, and undersized lines causing congestion and clogging in the system. According to the Utah State Division of Health Regulation, the existing sewer collection system requires rehabilitation.

The system has no industrial contributors and consists entirely of household, commercial, and public connections. It serves approximately 460 connections with a population of 1500 (3.2 persons per connection).

Table 16. Existing sewer collection system (Kaiserman, 1978).

5,000 L.F. of 15" sewer pipe	13,500 L.F. of 6" sewer pipe
5,400 L.F. of 10" sewer pipe	8,900 L.F. of 4" sewer pipe
5,000 L.F. of 8" sewer pipe	44 manholes

The average daily flow is 171,700 gallons which is equivalent to 117 gallons per capita per day (gpcd). This is slightly higher than normal, probably due to excessive water use because the community does not use water meters. The average annual maximum is estimated at 155 gallons per minute and the average minimum daily dry weather flow is estimated at 75 gallons per minute. The sewer system is primarily a sanitary system; however, at least one catch basin is connected to the collection system and it is suspected that other storm drain structures are connected. Because of the low average annual precipitation (8.4 inches) storm water has not caused significant problems.

A conservative estimate of infiltration/inflow to the system is 70 gallons per minute (gpm). It was estimated that 60 percent of the infiltration inflow to the Milford sewers is from leaky residential water connections (leaky sinks and toilets). The remaining 40 percent is probably from water lines through broken sewerline joints. Groundwater infiltration is not significant because the water level is at least 40 feet deep.

b. Existing Lift Station: Milford has one lift station. The station is designed with a wet well, chlorination room, and pumper room. Two 7.5-horsepower submersible sewerage pumps delivered up to 300 gpm through approximately 3600 feet of 6 inch diameter force main to the stabilization ponds. These pumps are working near design capacity due to the excessive inflow and improperly operating check valves in the force main.

c. Existing Wastewater Treatment System: Presently Milford pumps its sewerage to total containment lagoons approximately 3600 feet east of the town. The lagoons are designed to accommodate an influent from a design population of 2,000 and a flow of 240,000 gallons per day (167 gpm or 120 gpcd). The lagoon has four cells operated in series (Table 17). The total lagoon area is 34.4 acres. The lagoon was sized based on a net annual evaporation (evaporation minus precipitation) of 39.5 inches, and a daily percolation rate of 0.005 inches.

Complete containment lagoons were installed because of the high net evaporation rate, the relatively inexpensive land, restrictive surface water discharge standards (Table 18), and low technology operating requirements. Requirements for Class "C" and "D" waters are shown in Appendix A--pages V-13 through V-16 in Kaiserman (1978).

d. Existing Storm Water System: Storm water runoff is not a problem at this time. As is typical along desert basin margins, the

Table 17. Milford complete containment lagoon.

Cell Number 1:	Primary Pond 10.1 acres
Cell Number 2:	8.5 acres
Cell Number 3:	7.9 acres
Cell Number 4:	7.9 acres
Average Depth Equals 5 Feet	

Table 18. Summary of discharge standards.

Type of Discharge	Level of Treatment
Surface Water	Meet polished secondary treatment and maintain Class "C" standards in receiving streams
Irrigation - confined	Class "D" water standards
Irrigation - unconfined	Polished secondary treatment

little rainfall (8.4 inches per year) produces little runoff. That which occurs is sheet-flow which quickly infiltrates into the permeable soil on mild slopes. These conditions also minimize the impact of runoff from the surrounding drainage areas on Milford.

2. Maximum Capacity Without Changing System.

The present sewage collection system does not meet state standards for the existing population. The existing pump station was designed to support a population of 1650 (250 gpcd peak design flow). Any significant increase in the population would require larger sized pumps, larger wet wells, and an enlarged force main. The present lagoon system is designed for a population of 2000 and a flow of 0.24 mgd.

3. Implications of Major Growth.

The population impact due to MX was given in the Milford water system section. It is anticipated that major residential growth would take place north and west of Milford. Completely new sewer collection systems would be required for the new areas, and major portions of the existing system would need to be replaced. New lift stations capable of pumping 1.6 mgd would be required. This flow is based on 120 gpcd and a projected population of 13,500.

Kaiserman (1978) recommended a design seepage rate of 0.125 inches per day (3.8 feet per year) for lagoon design rather than the 0.005 inches per day (0.2 feet per year) used previously. Based on this assumption a complete containment lagoon area of 256 acres would be required to support a population of 13,500 with 120 gpcd flow. Assuming an organic loading of 0.17 pounds BOD per capita day and a maximum loading rate to the primary cell of 40 pounds BOD per day per acre, total primary cell area should not be less than 57 acres.

Most new residential development is expected to take place north and west of town. The natural drainage pattern would direct any storm runoff from this area through town. Proper design is required to provide grading and curbs and gutters that route surface runoff into uninhibitated areas with high soil permeability.

Conclusions: The present Milford sewer collection system is inadequate because of design deficiencies, cracking and material breakdown of the sewerlines, and undersized lines causing congestion and clogging. The projected MX growth would cause a six-fold increase in population by 1987. Flow would increase from 0.24 mgd to 1.6 mgd. A completely new sewer collection system would be required for the new population, and major modifications would be needed to upgrade the current system. Depending on the location of new lagoons, new lift stations would be required to pump 1.6 mgd. Kaiserman (January 1978) recommends that increases in storm water runoff due to expansion of the community be routed around town to infiltration areas by a system of surface canals, culverts and detention ponds.

Over 200 additional acres of lagoons will be required to completely contain the wastewater that would be associated with construction of the MX system. A summry of the Milford wastewater system existing and projected capacities is in Table 19.

Table 19. Summary of Milford wastewater existing and projected capacities.

Item	Population and Number of Connections	Collection System	Treatment System	Storm Water
Present Use	1,500 (460 connections)	Essentially complete sanitary sewer with vitrified clay pipe and oakum and/or motor joints. Substandard. condition. One pump . station of adequate capacity. Maximum daily flow of 160 gpm.	One four cell complete containment lagoon of 34.4 total acres. Design based on an average net evaporation and seepage loss of 3.5 feet per year. Organic load = 0.17 pounds BOD per capita day. Maximum organic load to primary cell not to exceed 40 pounds BOD per acre.	The area only receives about 8 inches of rain per year. Surface drainage is adequate.
Present Capacity	1,650 (500 connections)	The present collection system is operating a capacity. The pump station can support a population of 1650 (230 gpcd peak design flow).	The present lagoon system is designed for a population of 2000 and a flow of 0.24 MGD (120 gpcd).	Surface drainage is adequate.
Required Capacity in 1987 Without MX	2,000 (613 connections)	New collector pipes and modifications to the lift station.	The present lagoon is adequate.	Proper design of new structures to route surface flows.
Required Capacity in 1987 with MX	14,500 (4500 connections)	New collector system and replacement of major portions of existing systems. Completely new pump stations.	A total requirement of 256 acres including 57 acres of primary cells. Based on 3.3 feet per year net evaporation and 3.8 feet per year seepage (1/8 inch per day).	Proper grading to properly route surface runoff around town.

II. Delta City

1. Existing Collection and Treatment Systems.

a. Collection system: Kaiserman Associates Inc. (September 1979) conducted a study for the City of Delta to identify problems within the existing water, sewer, and storm drain utility systems, and to develop solutions to facilitate projected growth. The detailed information on the existing water and sewer systems of Delta was provided by studies and final engineering designs prepared by Call Engineering.

The present collection system is comprised of vitrified clay pipe, some with oakum joints and some with open joints. Sections of asbestos concrete (particularly for the larger sizes) and PVC pipe have recently been added. Presently the collection system consists of nearly 8.5 miles of pipe and 90 manholes (see Table 20). The lines serve approximately 775 connections, with an average 2.71 persons per connection. No storm drains directly enter the sewage collection system.

Table 20. Present sewer collection system for Delta, Utah.

Length (ft)	Pipe Size (in)	Material	Allowable Infiltration[a] (GPC)
950	6	V.C.	1,620
28,100	8	V.C., A.C., PVC	63,900
9,100	10	V.C., A.C.	25,860
4,150	12	A.C.	14,160
2,400	15	A.C.	10,230
Total 44,700			

[a]EPA standards allow 1500 gpd/inch diameter/mile of pipe.

Delta presently produces an average daily wastewater flow throughout the year of 0.397 mgd (187 gallons per capita day). The peak daily flow is nearly 400 gpm. A high water table contributes to an estimated infiltration rate of 90 gpcd which exceeds the EPA allowable infiltration rate standard of 55 gpcd. Table 21 shows the monthly average sewage flow for the period 1975-1977 (Kaiserman, 1979).

Table 21 indicates that maximum flows occur during the summer when irrigation raises the water table and increases infiltration. Low flows occur in February, but even then a flow as high as 143 gpcd indicates some "dry weather" infiltration.

Although most of the sewage flow is gravity-flow, the flat topography necessitates three lift stations designated A, B, and C. Stations A and C are intermediate stations which provide sufficient elevations for gravity

Table 21. Monthly average sewage flows for Delta (1975-1979).

Month	mgd	gpcd
October	0.368	173
November	0.350	164
December	0.349	164
January	0.319	150
February	0.305	143
March	0.326	153
April	0.330	155
May	0.410	192
June	0.479	225
July	0.541	254
August	0.569	267
September	0.423	198
Average	0.397	187

lines to feed station B which pumps the total city load through a 10" force main 7900 feet to the treatment lagoon south of town. The characteristics of the pump stations are shown in Table 22. Backup diesel power generation equipment has been installed at lift stations A and B.

b. Sewage Treatment Facility: The City of Delta utilizes a detention (stabilization) lagoon system constructed in 1971. Water elevation control stations are located between the six cells of the lagoon system. Table 23 shows the characteristics of the system.

The detention lagoon was designed to accommodate the waste load for a design population of 3500 people plus an anticipated industrial

Table 22. Sewage pump stations.

Pump Station	Pump	Capacity	Load (gpm)	Comment
A	Two alternate-operating 5.0 HP lift pumps	Each pump has a capacity of 575 gpm against 18 feet of head	235 (ave month) 335 (peak month) 416 (peak day)	Chlorination
B	Two alternate-operating 9.4 HP pumps	Each pump has a capacity of 550 gpm against 35 feet of head	276 (ave month) 395 (peak month) 490 (peak day)	
C	Two alternate-operating 5 HP pumps	Each pump has a capacity of 550 gpm against 12 feet of head	41 (ave month) 59 (peak month) 74 (peak day)	

Table 23. Wastewater stabilization lagoon.

Cell	Maximum Water Surface Area (acres)	Total Capacity When Full (acre feet)
Primary	20.0	56.8
2	8.3	39.4
3	8.3	39.4
4	8.0	37.0
5	8.3	39.4
6	8.3	39.4
Total	61.2	251.4

BOD load of 200 pounds/day. A hydraulic flow of 150 gpcd and a domestic BOD load of 0.17 pounds per capita per day were assumed. The system was designed to detain an average waste flow of 0.525 mgd for 150 days before discharging it to a nearby irrigation canal.

To date only the first three cells of the lagoon system have ever approached capacity and no effluent has ever been released. Consequently, under current loading conditions the system is operating as a complete containment lagoon. Water losses from the three ponds approach 12.2 feet per year. Assuming net evaporation loss to be 3.9 feet per year (47 inches per year) then seepage losses amount to 8.3 feet per year (98 inches per year). Kaiserman (1979) recommends that this substantial seepage rate be considered to avoid oversizing in future lagoon design. The maximum recommended seepage rate by Utah State standards is 0.25 inches per day (91 inches per year) and this seepage rate will be assumed for calculations in this report.

The existing detention pond system has experienced a few operational problems. The diking has shown some signs of slow deterioration due to erosion and wave action. The ponds have produced foul odors during the spring "overturn" in March and April. Flow meters were vandalized, so no flow data are available.

Revenues to operate and maintain the sewerage system are generated by connection fees and assessment of a monthly service charge as shown in Table 24.

No integrated storm drain system presently exists in Delta. The municipal irrigation network throughout Delta captures much of the storm runoff and transports it to low-lying agricultural fields within the city limits. The general lack of topographical relief in the study area attenuates flood flows and reduces erosion. Infiltration rates are relatively slow (0.02 to 0.60 inches per hour) within Delta and contribute to the tendency for rain water to pond in certain areas. Delta does not receive measurable runoff from upland slopes located outside the city limits.

2. Maximum Capacity Without Changing the System.

The existing wastewater collection system and lift stations are adequate for the present population. However, a program should be implemented to clean all collection lines on a five-year rotating basis.

Table 24. Fees for wastewater service.

Type of Fee	Cost ($)
Connection Fee (50 feet of main with a 4 inch connector)	250.
Monthly Fee - Residential	3.
Monthly Fee - Commercial	3. to 10.

The existing facilities at lift station A are large enough to serve all development within the present service area and an additional 50 acres south of the lift station. Lift station C presently pumps a small portion of the total flow from Delta and is also more than adequate. Lift station B is pumping a peak daily flow of about 400 gpm and serving the entire population of Delta. A large portion of this flow is infiltration and, therefore, flows will not increase in direct proportion to population growth if the new sewer lines are designed and installed to minimize infiltration. Assuming a flow of 140 gpcd and an excess capacity of 50 gpm at station B, the existing stations could accommodate a population increase of about 500 people to a new total population of 2600.

The existing lagoon system is more than adequate to support the population that could be serviced by the existing collection and lift stations.

3. Implications of Major Growth.

New sewer collection systems and pump stations will be required to support new growth. The design of these installations will depend on the locations within the community where the growth occurs.

The excess capacity in the existing lagoon should be utilized when the population of the town reaches a point where complete containment of the waste is no longer possible. In order to do so, Delta must obtain a NPDES permit to discharge lagoon effluent to the irrigation canal as planned. Detention ponds generally do not achieve sufficient removal to meet "Polished Secondary" effluent standards. Reynolds et al. (1977), have demonstrated the feasibility of using intermittent sand filters to polish stabilization pond effluent. Intermittent dosing and resting of the filter maintains aerobic conditions in the surface layers, allowing for further oxidation of the waste load and minimizing clogging of the filter.

Intermittent sand filters are usually loaded hydraulically once a day during a four to six hour period. When a single dose to a filter will not percolate through it within the remaining 18-20 hours of the day it is considered plugged, and the filter sand needs to be reconditioned or removed. Periodic reconditioning of the filter surface may be accomplished by raking, scraping, or washing the top 2-3 inches of sand. If the sand is removed, it may serve as an excellent soil conditioner.

A maximum intermittent sand filter surface area of approximately 0.6 acres would be required to accept a surface hydraulic loading of 0.4 million gallons per acre per day (mgad) because 25 percent of the surface area needs to be considered as being dewatered for cleaning.

Bed depth would be 2-3 feet, and an underdrain system should be provided beneath each filter. Techniques have been developed to minimize freezing problems related to filter operation during the winter.

Effluent provided from the filter, if operated and maintained properly, should meet the 1985 requirements of 15 mg/l BOD and 10 mg/l suspended solids. Chlorination facilities would also be required to chlorinate the effluent prior to release to a receiving water. Probably the two most cost effective techniques for treating the wastewater from Delta would be complete containment or a stabilization lagoon followed by intermittent sand filtration.

a. Complete Containment: Kaiserman (1979) estimated that if the new sewer lines were installed properly, the average flow would be approximately 130 gpcd. Assuming a net evaporation rate of 3.9 feet per year and seepage losses of 8.2 feet per year, 64 acres of lagoon area would be required to service the projected population of 5300 associated with the IPP project. Based on the same assumptions, 187 acres would be required to support the projected 15,550 population associated with both the IPP and MX projects.

b. Detention Pond With Intermittent Sand Filtration: State regulations limit the waste load sent to the primary pond to 40 pounds per acre per day to avoid odor problems. State regulations also require a 120-day detention period. Based on these standards, a lagoon area of 56 acres would be required for a population of 5300. Assuming a filter loading rate of 0.4 million gallons per acre per day, 2 acres of filter area would be required to support the population. Based on the same standards, 164 acres of lagoon and 7 acres of intermittent sand filter would be required for a population of 15,550 people. A summary is included in Table 25.

Extensive storm drain systems are not recommended for Delta because of its arid climate. New commercial and higher density residential developments in eastern Delta should be provided with storm flow facilities such as curbs, gutters, and waterways to transport surface runoff to strategically placed enclosed pipe storm drains. These can discharge into existing drains and irrigation canals that carry the water out of the city where it can infiltrate on undeveloped land.

Table 25. Summary of Delta wastewater existing and projected capacities.

Item	Population and Number of Connections	Collection System	Treatment System	Storm Water
Present Use (1980)	2100 (775 connections)	Essentially complete sanitary sewer with vitrified clay pipe having oakum or "open" joints. Adequate condition. Three pump stations of adequate capacity. Average monthly flow rate of 276 gpm (190 gpcd). The peak monthly flow rate of 335 gpm (229 gpcd) is reached during irrigation season.	One six-cell detention lagoon of 61 total area. Design based on 120 day detention and an organic load of 0.17 pounds BOD per capita day. Due to high actual evaporation and seepage rates the pond is presently functioning as a complete containment lagoon.	The area only receives about 8 inches of rain per year. Surface drainage is adequate.
Present Capacity	2400 (890 connections)	The capacity of the system is limited by the capacity of the collection sewers and the capacity of pump station B.	Due to the high evaporation and seepage rates, the present lagoon system is more than adequate to function as a complete containment lagoon for the existing sewer collection system.	Existing conditions are adequate. New and more dense residential and commercial developments should be provided with adequate surface drainage facilities such as curbs, gutters and waterways.

Table 25. Continued.

Item	Population and Number of Connections	Collection System	Treatment System	Storm Water
Required Capacities (1987): With IPP, Without MX	5300 (1960 connections)	New sewer collection systems and pump stations would be required to serve the new development.	A complete containment lagoon for this population would require 64 acres which is only slightly more (3) acres than is currently available. The existing lagoon might function adequately at the 5% overload caused by not expanding an additional 3 acres.	Existing conditions are adequate. New and more dense residential and commercial development should be provided with adequate surface drainage facilities such as curbs, gutters and water ways.
Required Capacities (1987): With Both IPP and MX	15,550 (5900 connections)	New sewer collection systems and pump stations would be required to serve the new development. Assuming new lines are installed properly to prevent infiltration, the estimated average monthly flow would be 2.6 MGD (130 gpcd).	A complete containment lagoon for this population would require 187 acres of lagoon area. Conventional design of a detention lagoon followed by intermittent sand filtration would require a lagoon of 164 acres and 7 acres of sand filters. If 12.1 feet per year were allowed for seepage and net evaporation, the lagoon area would be 117 acres and the sand filter area of 2 acres.	Existing conditions are adequate. New and more dense residential and commercial development should be provided with adequate surface drainage facilities such as curbs, gutters and water ways.

III. Cedar City

1. Existing Collection and Treatment System.

Cedar City is the largest community covered in this study, but because of its greater distance from the proposed MX construction sites the population growth projections indicate that it may receive the smallest percentage population increase.

The sewage collection lines were constructed early in the 1930s and later expanded as needed (208 WQMP, 1977). In 1949 additional lines were installed, and an Imhoff tank was constructed for sewage treatment. The effluent from the Imhoff tank was used for irrigation. There are no reported high groundwater levels in Cedar City. As a result, there are no infiltration problems. Measurements taken in 1970 indicate an average daily flow of approximately 100 gallons per capita day (208 WQMP).

In order to upgrade the quality of the effluent and meet current water quality standards, a new treatment plant was constructed and went into operation in December 1977. The plant consists of a 100-foot diameter primary trickling filter; an 80-foot diameter secondary trickling filter; primary, intermediate, and final clarification; two 12-foot diameter microfloc, gravity-flow, mixed media filters; and two 50-foot diameter sludge digesters. Effluent from the sand filters discharges to a 8-million gallon holding pond. From this pond, water may be released by gravity flow to irrigate farms north of the plant or pumped by two 350-hp pumps to the North Field Ditch for delivery to other irrigated areas.

The original plan at the time the plant was designed was to pump the water from the 8 mg pond to a 150 mg holding reservoir from which gravity flow would provide water for sprinkler irrigation of the City cemetery, golf course, ball park, highway median, and high school and college lawns. However, because the effluent does not meet the State Standards of 10 mg/l biochemical oxygen demand (BOD), 5 mg/l suspended solids (SS), and three total coliform/100 ml, use of the effluent has been restricted to flood irrigation of approved types of agriculture and for watering the highway medians (Fred Pearson, personal communication).

Data were obtained from the Cedar City Wastewater Treatment Plant (WWTP) on flow, biochemical oxygen demand (BOD), suspended solids (SS), pH, total coliform, and fecal coliform, and these are shown in Table 26. Flow data were available for the period August 1979 to November 1979. Quality data were available for the period December 1976 to January 1980.

Flow data were collected at approximately 2-hour intervals from 6:00 to 16:00 on week days, and consequently the calculated average flows are probably higher than the true daily averages. However, the maximum and minimum values may be representative. The average effluent BOD of 220 mg/l is only slightly greater than a typical value of 200. Mr. Doug Craig of Engineering Science, Denver (personal communication) has been evaluating the plant as part of an EPA operation and maintenance state pass-through grant. Based on 102 samples collected in 1979 he calculated an average hydraulic loading (without circulation) of 158 gpd/ft^2 to the primary and 298 gpd/ft^2 to the secondary trickling filters. The current recycling is not gaged; however, it could result in hydraulic loadings 2 to 3 times those above or about 395 gpd/ft^2 and 745 gpd/ft^2 for the primary and secondary respectively. Typical hydraulic loading rates are between 200-900 gpd/day/ft^2. Mr. Craig calculated average hydraulic loading rates

Table 26. Summary of available data at the Cedar City Wastewater Treatment Plant (one standard deviation is shown with averages).

Parameter	Average	Maximum	Minimum	Number of Data Points	Comments
Average Influent Flow (gpm)	1262 ± 203	1736	895	40	Average over period 6:00 - 16:00
Minimum Instantaneous Flow (gpm)	431 ± 68	-	349	58	Minimum in period 6:00 - 16:00 (min. occurs at 6:00)
Maximum Instantaneous Flow (gpm)	1770 ± 330	2822	-	50	Maximum in period 6:00 - 16:00 (max. occurs between 10:00 and 14:00)
Influent BOD (mg/l)	220 ± 40	268	141	39	Grab samples
Effluent BOD (mg/l)	28 ± 20	70	8	39	Grab samples
Influent SS (mg/l)	172 ± 46	358	92	39	Grab samples
Effluent SS (mg/l)	10 ± 6	25	1	39	Grab samples
Influent pH	7.5 ± 0.4	8.3	6.8	39	Grab samples
Effluent pH	7.6 ± 0.3	8.3	7.0	39	Grab samples
Effluent Total Coliform (Log count/100 ml)	2.67 ± 0.62	3.86	1	37	Grab samples
Effluent Total Coliform (count100 ml)	$\overline{468}$	7200	10	37	Grab samples, Geometric mean
Effluent Fecal Coliform (Log count/100 ml)	1.06 ± 0.81	2.92	0	37	Grab samples
Effluent Fecal Coliform (count100 ml)	$\overline{11}$	835	1	37	Grab sample, Geometric mean

ot 28 pounds BOD/day/1000 ft^2 and 9 pounds BOD/day/1000 ft^2 for the primary and secondary trickling filters respectively. Typical organic loading range between 10 and 60 pounds BOD/day/1000 ft^2.

Table 26 indicates high effluent BOD concentrations. Several factors may contribute to the high effluent BOD concentrations from a modern plant operating within practical theoretical ranges for hydraulic and organic loadings: 1) toxic or growth inhibiting materials in the influent and 2) suboptimal operating procedures.

Little effort has been made to control industrial waste discharges into the collector system. There are two apparent sources of organic loading. The Cedar Packing Company discharges process wastes to the sewer with an estimated daily flow of 4,100 gallons and 250 pounds of BOD (208 WQMP). The Coca-Cola Bottling Company discharges process wastes to the sewer with an estimated average daily flow of 11,000 gallons and a BOD of 2 pounds. A paint factory and numerous gas stations and mechanics shops may also discharge to the sewer systems. Vernile Terry (personal communication) reported a massive gas spillage entering the plant over a two day period in January 1979. The discharge damaged the biological growth and resulted in effluent BOD concentrations of over 70 mg/l. It took the plant several months to recover.

Trickling filters in Utah do not normally produce low soluble BOD in the effluents. However, it may be possible to improve the present quality of effluent at the Cedar City plant by altering operating procedures.

2. Maximum Capacity Without Changing the System.

The existing collection system is adequate for the present population. The two main sewers entering the wastewater treatment are operating at 60 to 70 percent of capacity. Extrapolating, the existing sewer mains would be adequate for a population of 19,000, but normal collector lines would be required for the areas of expansion.

The treatment plant was designed for 2.26 mgd (a population equivalent of 19,000). However, the data in Table 26 indicate that the effluent concentration already exceeds state standards much of the time. Unless the performance of the plant can be improved to reach design criteria, new facilities will need to be constructed for any increase in population. Plant performance may possibly be improved by restricting toxic chemicals from the sewer system, by requiring pretreatment of high organic industrial discharges to the sewer system, by trying alternate plant operating procedures, and by providing operator training.

The State of Utah specifies a maximum peak flow rate of 5 gpm/ft^2 when a proportionate number of filters are removed from operation for the periodic backwash cycle. Using these criteria, the filter system is inadequate to serve the present population.

3. Implications of Major Growth.

Normal expansion of the sewer collector system will be necessary to serve developing areas. If the existing plant performance can be improved to meet the design capacity of 19,000 population equivalents, then it is conceivable that the plant could serve the projected populations of Cedar City with MX in 1987 by operating at a 5 percent overload. Plant improvement could possibly be obtained by restricting the materials being discharged to the sewer system and by implementing operating modifications. Approximately 700 square feet of additional filter area would be required to comply with State specifications at a population equivalent of 19,900.

The historical data indicate that improvement of plant performance is unlikely and that additional treatment facilities will be required. The most likely methods would be an oxidation ditch or a stabilization lagoon followed by sand filtration.

IV. Hinckley, Deseret, and Oasis

1. General.

Kaiserman Associates (October 1979) conducted a Regional Utility Study to identify problems within the existing Hinckley, Deseret, and Oasis wastewater disposal systems and to propose recommendations to enable these communities to support various levels of projected growth. One growth scenario included population increases due to construction of the Intermountain Power Project (IPP), a 3,000 megawatt coal-fired electric power generating plant proposed for construction 10 miles north of Delta. Kaiserman (1979) estimated that IPP construction would cause a rapid increase in population reaching a peak in 1987 and then declining to a more stable base population, including IPP permanent support personnel, by about 1990. They also estimate that approximately 10 percent, 5 percent, and 3 percent of the total IPP construction and permanent support populations will reside in Hinckley, Deseret and Oasis respectively. The population projections for this three-community area are shown in Table 27. The population associated with MX is based on the assumption that 18 percent of the total MX population will reside in these three communities.

2. Existing Wastewater Collection and Treatment Systems.

The residents of Hinckley, Deseret, and Oasis presently use individual domestic septic tanks and drain fields for sewage disposal. The majority of these systems do not function properly due to low soil permeability and a high groundwater table. Soil permeabilities are classified as medium (0.6 to 2.0 inches per hour), medium low (0.2 to 0.6 inches per hour), and

Table 27. Projected populations for the Hinckley-Deseret-Oasis area.

Situations	1980	1987	1995
Growth without IPP and MX (Kaiserman)	925	1050	1160
Growth with IPP but without MX (Kaiserman)	925	1600	1410
Growth with IPP and MX	925	4000	2700

low (0.06 to 0.2 inches per hour). The Utah State Division of Health requires permeability rates exceeding 1.0 inch per hour for septic tank installations. The groundwater reservoir beneath these three communities is comprised of three zones; a shallow purched aquifer and two artesian aquifers.

As a result of the inadequate drainage, many residents of these three communities have abandoned their septic tanks and connected their wastewater lines to land drains which had been installed in past years to lower the groundwater table. The wastewater discharged into the land drains eventually surfaces in open ditches causing health hazards, unsightly algal growth, and offensive odors. When the land drains are blocked, the groundwater builds up and causes flooding in nearby basements.

3. Maximum Capacity Without Changing the Systems.

Kaiserman Associates (1979) concluded that the present wastewater disposal systems do not meet state and federal regulations. They recommend that each community install sewer collection systems and transport the wastewater to containment lagoons. In order to provide adequate treatment and to accommodate the expected permanent support personnel for the IPP project, they recommend an 11-acre lagoon to serve Hinckley and an 8-acre lagoon to serve Deseret and Oasis. Because of the existing groundwater conditions, Kaiserman Associates recommend that the sewer lines be placed above the existing land drains wherever possible in order to allow the land drains to work effectively in draining the groundwater. They also recommend that all existing wastewater connections be transferred to the new sewer lines. However, to hold the new system to a reasonable size, they emphasize that no roof drains or connections which would permit groundwater, surface water, or runoff to enter the sewer system should be allowed. After the new wastewater system is installed, the existing land drains should be cleaned.

There are some locations in the area that are acceptable for septic tanks and leach fields. Each propsective home location must be considered individually to determine whether or not it meets State design criteria.

4. Implications of Major Growth.

a. Projected Wastewater Loads: The communities in the study area do not have a way of monitoring wastewater. It is assumed (Kaiserman, 1979) that wastewater amounts are similar to those from other communities in the area or 70 gpcd plus infiltration of 30 gpcd or a total of 100 gpcd delivered to the treatment facility. Table 28 summarizes the design criteria proposed by Kaiserman (1979).

Table 28. Wastewater design criteria.

1) Evaporation equals 47 inches per year (80% during May-October period)
2) Precipitation equals 7.1 inches per year
3) Lagoon seepage loss equals 46 inches per year
4) Allowable organic loading for a primary pond equals 40 lbs BOD/acre/day
5) Total flow (including infiltration) = 100 gallons per capita per day
6) BOD load equals 0.17 pounds BOD per capita per day (i.e. 200 mg/l at a flow of 100 gpcd)

Based on analysis of several wastewater treatment alternatives, Kaiserman Associates (1979) concluded that the only two feasible options were 1) complete containment lagoons or 2) stabilization ponds (120 days) with land application. Stabilization ponds with land application has several disadvantages. A winter storage reservoir would need to be constructed in order to hold water until the growing season and at least one lift pump would be required for irrigation delivery. In order to protect public health, land applications would only be allowed to and having a relatively low groundwater table in areas restricted from public access (1000 foot buffer zone). Overall, the area does not have good conditions for land application, and it was concluded that the complete containment lagoon would be the more cost effective treatment method.

Based on the population projections in Table 27 and the design criteria in Table 28, the area required for complete containment lagoons are shown in Table 29.

c. Conclusions: The wastewater treatment in Hinckley, Deseret, and Oasis is presently provided by individual septic tanks and leach

Table 29. Areas of complete containment lagoons for possible situations.

Situation	1987		1995	
	Flow (acre-ft/yr)	Area (acres)	Flow (acre-ft/yr)	Area (acres)
Growth without IPP and MX	116	16	128	18
Growth with IPP but without MX	176	24	155	22
Growth with IPP and MX	440	61	297	41

fields. Because of the generally low permeability of the soil and the high water table, existing conditions violate State and Federal standards and could cause health hazards. Land drains do not function properly because they are being used as wastewater lines and, consequently, shallow water tables rise causing further deterioration of the wastewater situation.

Sanitary sewer collection systems will need to be constructed for each of the communities. The sewer lines should be placed above the existing land drains wherever possible in order to allow the land drains to work effectively in draining the groundwater. Storm drains should be kept entirely separate from the sanitary sewer system.

The required containment lagoon area for the three communities would increase from about 19 acres to between 41 to 61 acres with the influx of MX personnel. This drastic increase in magnitude justifies reconsideration of the number and location of lagoons.

V. Garrison.

There is no public sewer system in Garrison. Residential wastewater disposal is by individual septic tanks and drainage fields. Oxidation ponds appear to be the most cost effective method of treating wastewater produced by major MX related growth in that area. The climate is similar to the Delta region and pond areas for any assumed population can be estimated by using the per person quantities given in Table 25.

SUMMARY

The impacts of the proposed MX missile complex upon the water supply and waste treatment systems of the Utah municipalities of Milford, Delta, Cedar City, and the smaller communities of Hinckley, Deseret, Oasis, and Garrison were analyzed. For purposes of estimating the impact of the MX complex, the total associated population increase within Utah was taken as 30,000 during a construction phase peaking in 1987 and then 15,800 on a permanent basis after construction is completed. The distribution of this population increase among the affected communities was taken as follows:

	MX Population Increase	
Community	Construction Peak	Permanent
Milford	12,500	6,600
Delta	10,250	5,410
Hinckley, Deseret, Oasis	2,250	1,190
Cedar City	5,000	2,600

These population increases were assumed as being additional to the number of people who would otherwise be living in each community. The impacts were estimated from a per capita basis so that the effects of other popuiation totals or distributions could be easily estimated.

Hydrologic System

All of the communities examined currently obtain their entire water supply from groundwater. No surface water is currently being used because of the much less expensive, good quality groundwater which is usable without treatment. Nor is there any expectation of surface water being developed for municipal use through the next decade during which MX impact is scheduled to peak. Cedar City has plans underway to import and treat

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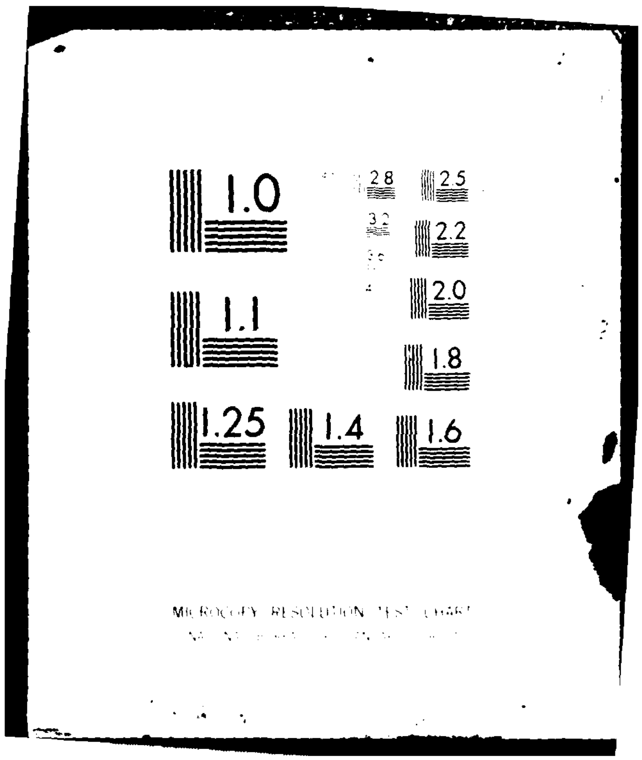

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surface water in the more distant future. For this study, the evaluation of the hydrologic system focused entirely on groundwater.

All of the communities obtain their groundwater from wells pumping from unconsolidated sediments in the valley bottoms, and these aquifers seem to be the economically feasible source for MX related increases in municipal water production (usually with a corresponding decrease in irrigated agriculture). Cedar City also has substantial production from springs located on alluvial fans in two adjacent canyons.

In two of the three principal cities (Milford and Delta), groundwater of excellent quality is being produced from wells within the City boundary while nearby irrigation wells, north and south of both Cities, produce water of unacceptable salinity (also unacceptable arsenic levels south of Delta). In Milford, the poor quality water is generally from a shallow aquifer; and the deep aquifer (from which City wells produce) has kept its high quality due to artesian pressure which leaks fresh water upwards rather than allowing shallow contaminated water to enter the deep aquifer. However, aquifer outflow exceeding recharge (mining) has occurred in recent years, and further increases to supply MX-related demand could reverse the pressure gradient and contaminate the deep aquifer.

Delta is located over a relatively isolated (but limited) reservoir of fresh, low salinity water. Here also, groundwater is already being mined, and any major increase in pumping will eventually cause deterioration of the aquifer quality. Thus in both communities, water quality deterioration is the limiting factor to further groundwater development.

In Cedar City, the single municipal well within the City produces water unacceptable for culinary purposes and therefore is used for irrigation. The municipal system obtains its high quality supply from deep wells several miles north and south of the City.

In and around all of the communities studied except Garrison, the Utah State Division of Water Rights has closed the basins to further groundwater (and surface water) appropriations. Therefore, any additional municipal groundwater withdrawls will have to come from either 1) existing rights held by the communities above their present production rates or 2) water rights purchased from farmers (which imply a decrease in irrigated agriculture) and converted from agricultural to municipal uses. The conversion will probably require a change in point of diversion with its associated facility costs. Any conversion requires approval by the State Engineer. Considerations related to such approvals include local drawdown increases (interference with other wells) and possible water quality deterioration due to pressure gradient changes. In some cases approval may be obtained when others are adversely affected provided that they receive acceptable compensation for their increased pumping lifts.

Water Supply Systems

1. Milford: Milford City, with a present population of 1500, has an adequate system except for insufficient storage capacity and considerable water loss through leaking mains. The peak day demand, however, is already close to pumping capacity. Without MX, the 1987 demand will require one more well (for which they already have the necessary water right), an additional 0.25-mg reservoir (or preferably replacement of existing deteriorated reservoirs with a larger one), and some modest improvement and expansion of the distribution system.

With projected MX growth, however, the population would increase from 1500 to 14,500 in seven years. Every component of the existing system would be totally inadequate and an essentially new water system would be required to serve the largely new City. The amount of expansion is perhaps best illustrated by the required increase in peak day pumping capacity from the current 1.63 to 10.7 mgd. This would require a network of new wells (six additional 1,000 gpm wells for example) and the purchase of additional water rights from farmers which would remove the equivalent of about 600 fully irrigated acres from production. Despite this major increase in municipal pumping, agriculture so dominates the existing pumped groundwater volume in the valley (98 percent compared to 2 percent for municipal) that the overall hydrologic system will scarcely be impacted Great care will be necessary, however, to avoid local well interference and water quality deterioration through proper siting and sizing of the new wells.

2. Delta: Delta City has a water system which is completely adequate for the present 2100 population except for a shortage of reservoir storage. It would even be adequate for the projected 1987 population of 5300 (assuming IPP is constructed but MX is not) except for a needed additional increase in storage and expansion of the distribution system to serve new users. As in the case with Milford, however, the additional population growth associated with MX construction (an increase from 2100 to 15,550 in seven years) would make all water system facilities completely inadequate. The peak day pumping capacity would be required to increase f 73 mg (1.15 actual peak day use) to 8.5 mg. A new well field would be r aired to produce about 5000 additional gpm during peak periods This may be

possible but would likely be difficult on a long term basis because of the relatively close proximity of brackish water to the north and high arsenic level water to the south. The facts that 1) this high pumping rate would be required only during peak summer months (average rate is only 43 percent of peak day) and 2) the population should decrease substantially during the following five years, due to completion of construction of both IPP and MX, suggests that the aquifer capacity and quality problems could be solved if the new well field is designed properly. The new well field would require the removal of 428 acres from irrigated agriculture in addition to the major reduction already caused by IPP (which has also increased water right prices in the area many fold).

3. Cedar City: The existing water system is adequate for present demand volume but is borderline in terms of peak day pumping capacity. The City has adopted a policy of purchasing all nearby surface or groundwater rights which become available and this has given them existing groundwater rights which with only a minor increase will be adequate for peak period 1987 demand including projected MX growth. The present total peak period pumping plus spring flow capacity is about 32 percent short of meeting 1987 demand with MX, but the City has already embarked upon a major expansion project which will produce a more than adequate water supply and distribution capacity for MX related growth. The existing 13,000 population of Cedar City would be increased by only about 50 percent in 1987. This contrasts with much greater population growth in the Milford and Delta areas and the relative impact upon Cedar City would therefore be much less.

4. Hinckley/Deseret/Oasis: These three communities south and west of Delta are served by a public water system in Hinckley and private wells in Deseret and Oasis. The current tri-city population is 925 and is projected to increase to 4,000 due to combined IPP and MX construction. The existing water source for Hinckley produces water with unacceptable arsenic levels. Naturally occurring arsenic levels exist in the deep aquifer in much of this region. The three communities are presently attempting to develop a regional water system with a well located 3 to 4 miles northwest and outside the area with the arsenic problem. The current plans for this system are to serve the IPP projected impact, but not MX. The planned capacities would have to be increased almost three fold to also handle MX demand. This would be difficult hydrologically in view of simultaneous huge growth in Delta City. The only way to successfully design new well fields for both Delta and Hinckley/Deseret/Oasis would be to combine all these systems into a single coordinated regional project. Even then, the ability to avoid serious well interference and deterioration of the deep regional aquifer is in doubt.

5. Garrison: The smal community of Garrison (population 60) has no existing public water system (private wells are used). Any MX related growth in this area would not have the advantage of an existing municipal infrastructure; rather a new city would have to be created. Growth in this area would have the advantage, however, of access to the most favorable water resource situation in the entire study area. Snake Valley has substantial amounts of good quality unappropriated groundwater. Growth in this area would not require a reduction in irrigated agriculture.

Wastewater Systems

Wastewater collection and treatment to serve an increased population does not present so difficult a problem in any of the communities examined as does water supply; that is, the basic constraint of water resource availability is not the relevant issue. The need is to obtain the necessary financial resources with sufficient lead time to construct the collection and treatment facilities. With the possible exception of Cedar City, which already has a tertiary treatment plant, the economically viable treatment approach for the communities is to construct oxidation lagoons. The availability of large areas of relatively inexpensive land near each community motivates this approach.

Both Milford and Delta already have oxidation lagoons, but as with the water supply system, the MX related growth will require much greater capacities. The Cedar City treatment plant is already overloaded. A question exists concerning type of expansion to Cedar City's treatment facility. If the effluent quality can be improved sufficiently (by adding additional capacity) to allow recycling by sprinkling public areas such as the college and golf course, this would have the advantage of reducing demand upon the culinary supply system. If not (and previous results are not encouraging), then the more cost effective expansion investment may be to add an oxidation lagoon.

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APPENDIX A

EFFLUENT AND RECEIVING STREAM STANDARDS

Summary of Discharge Standards

Discharge To	Level of Treatment
Surface Water	Meet polished secondary treatment and maintain Class "C" standards in receiving stream.
Irrigation--confined	Class "D" water standards
Irrigation--unconfined	Polished secondary treatment

The water quality requirements for Class "C" and "D" waters are shown on the following pages.

Utah Effluent Standards

Parameter	Secondary Treatment	Polished Secondary Treatment
BOD		
(30 day arithmetic mean)	25 mg/l	15 mg/l
Maximum % of influent	15%	10%
Suspended Solids		
(30 day arithmetic mean)	25 mg/l	10 mg/l
Maximum % of influent	15%	10%
Total Coliform		
(30 day arithmetic mean)	2000/100 ml MPN	200/100 ml MPN
Fecal Coliform		
(30 day arithmetic mean)	200/100 ml MPN	20/100 ml MPN
pH Units (range)	6.5 - 9.0	6.5 - 9.0

Summary of Class "C" Water Quality

Requirements, August 1971

It should be unlawful to discharge wastes resulting in:

- Objectionable deposits
- Floating debris, oil, scum and other matters
- Objectionable color, odor, taste, turbidity
- Interference with Class "C" water uses

The following standards shall not be violated:

Item	Limits: Recommended Mg/l	Limits: Mandatory Mg/l	Item	Limits: Recommended Mg/l	Limits: Mandatory Mg/l	Item	Limits: Recommended Mg/l	Limits: Mandatory Mg/l
TDS	500		Cu	1.0	--	NO_3	45	--
As	0.01		CN	0.01	0.02	Pheno	1.001	--
Ba	--		F	1.0	2.0*	Se	--	0.01
CCE	0.2		Fe	0.3	--	Ag	--	0.05
Cd	--		Pb	--	0.05	SO_4	250	--
Cl	250		Mn	0.05	--	MBAS	0.5	--
Cr	--					An	5.0	--

MPN Coliforms 5000/100 upper limit (average)
BOD 5 mg/l upper limit
DO 5.5 mg/l lower limit
Radionuclides not to exceed 1/30 of the MPC**
values as defined in National Bureau of Standards
Handbook 69

*Dependent on Climate
**Maximum permissible concentration in water

Uses of Class "C" Water:

- Municipal (following complete treatment)
- Aesthetics
- Irrigation
- Stock Watering
- Fish Propagation
- Wildlife
- Recreation (except swimming)
- Industrial Supplies
- Other as determined by Board and Committee

NOTE: A user of surface water diverted from water of the State will not be required to remove any pollutants which he has not added before returning the diverted flow to the original water course.

Summary of Class "D" Water Quality

Requirements, August 1971

It should be unlawful to discharge wastes resulting in:

Slicks
Floating solids
Suspended solids
Toxic materials
Interference with Class "D" waters

The following standards shall not be violated:

	Limits			Limits			Limits	
	Recommended	Mandatory		Recommended	Mandatory		Recommended	Mandatory
Item	Mg/l	Mg/l	Item	Mg/l	Mg/l	Item	Mg/l	Mg/l
TDS	500		Cu	1.0	--	NO_3	45	--
As	0.01		CN	0.01	0.02	Pheno	1.001	--
Ba	--		F	1.0	2.0*	Se	--	0.01
CCE	0.2		Fe	0.3	--	Ag	--	0.05
Cd	--		Pb	--	0.05	SO_4	250	--
Cl	250		Mn	0.05	--	MBAS	0.05	--
Cr	--					An	5.0	--

MPN Coliforms 5000/100 upper limit (average)
BOD 25 mg/l upper limit
Radionuclides not to exceed 1/30 of the MPC** values as defined in National Bureau of Standards Handbook

*Dependent on Climate
**Maximum permissible concentration in water

Uses of Class "D" Water:

Accepted	Unaccepted
Limited irrigation, industrial uses	Irrigation of pastures
Other as determined by Board and Committee	Irrigation of recreation areas
	Irrigation of root crops of any low growing crops produced for consumption.

NOTE: A user of surface water diverted from water of the State will not be required to remove any pollutants which he has not added before returning the diverted flow to the original water course.

Land Application

A sewage effluent may be discharged through land application by the following methods:

Irrigation of confined areas having controlled access:

Sewage effluent used for irrigation on areas which are fenced and have controlled access must meet secondary or Class "D" effluent quality.

Irrigation of unconfined, isolated areas:

For irrigation of unconfined areas secondary treatment would be required.

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